Effect of Foliar Spraying with CytokininPhenyl Urea (CPPU), Kinetinand Benzyladinine (BA), on Abscission and Fruit Quality of "Le-Conte" Pear

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ABSTRACT

The main problem of the pear cultivar "Le-Conte" is large size of trees vegetative growth, this is due to the rootstock grafted on *pyrusbetulaefolia* , and also to high the fertility of the soil and the flood irrigation of the soil in the majority of site it is grown in the valley regions. Thus leads to diminish the productivity which poor quality attributes. Treatment were used foliar spraying at petal fall as follows; Gulliver (1% CPPU) 1, 0.5 and 0.25 cm/L, Gulliver 0.5 cm/L + GA_3 (10% gibberellic acid) 0.15 g/L, Kinetin(0.004%) 1, 0.5 and 0.25 cm/L, Kinetin0.5 cm /l + GA_3, benzyl adenine 0.0125 g/l and control. The following attributes were measured; fruit Set %, fruit retention %, yield (kg/tree), fruit characteristics (fruit weight (g), fruit firmness, juice TSS %, TA %), vegetative growth, chemical analysis (leaf content of nutrients nitrogen, phosphorus and potassium %) and hormones (GA_3, IAA and ABA) protein electrophoresis content. The best results were due to Gulliver (CPPU) 1 cm/L at petal fall statistically the best treatment increased fruit set and fruit retention percentage, yield, decreased vegetative growth, increased IAA and lowest ABA content which highest number of protein bands and higher net profit/feddan. Kinetin treatment 0.5 cm/L + GA_3 at petal fall induced the highest fruit weight, fruit size, fruit length, fruit width and gibberellic acid content compared to control during the three studied seasons.

Key words: pear, Le-Conte, growth regulators, cytokinin, yielding, vegetative growth.

INTRODUCTION

Qalyuob region in Qalyuobia Governorate, Egypt is characterized by fertile clay soil with a heavy texture and a high content of nutrients. It has great potential for growing various low-chilling pear cultivars, most of which is Le-Conte cultivar with abundant vegetative growth that reflects negatively on cropping in terms of both quality and quantity. Enhancing productivity under such circumstances and also with absence of pollinators is usually managed by application of growth regulators basically those inducing parthenogenesis as gibberellins and cytokinins.

GA_3affects fruit formation, abscission, cell elongation, apical dominance and photoperiod (Aboutalebi and Beharoznam, 2006). Spraying Le-conte pear trees with GA_3 increased the fruit set and quality (Vladymyr and Michael 2005,Yehia and Hassan, 2005 and Hegazi, 2011). Foliar spraying GA_3 at 20 ppm at full bloom induced uppermost fruit set, yield and fruit quality of pear (Chitu*et al*. (2007). Increments in firmness and T.S.S were also detected (Fathiet al., 2013).

Cytokinins are classified into two major groups: synthetic phenylurea derivatives, such as N-(2-chloro-4-pyridyl)-N9-phenylurea (CPPU), and adenine derivatives, which may occur naturally, such as kinetin and 6-benzylaminopurine (BA) (Nandi et al., 1989). Many researchers showed that foliar application of CPPU at petal fall on “Le-Conte” pear caused a significantly higher fruit yield and, firmness and lowermost values of fruit drop and acidity via spraying at 10 or 15 ppm CPPU (Assad, 2013; Fathiet al.2013; Roussos et al.2021). Spraying 10 ppm CPPU at two weeks after full bloom on "Costata" persimmon increased fruit yield and enhanced fruit quality (Guirguis*et al.*, 2010).).Exogenous kinetin significantly increased fruit set, yield, cell division and differentiation in pears (Muniz, 2014).

Exogenous kinetin significantly increase rate of endosperm cell division, grain weight (Yang *et al.*, 2002). While Kinetin + GA combination sprayed during the flowering period in pears showed increases in fruit set and yields (Muniz, 2014; Carra*et al.*, 2021).Also, spraying a combination of CPPU + GA_3 at fruit set stage

showed an effective impact inducing lowest fruit drop, greatest yield and fruit quality; on pear trees (Kabeel, and Fawaaz, 2005), on Apple and pear trees (Rademacher, 2015), using Benzylaminopurine (BA) a spray treatment at 0.023 g L-1 induced a delay of ethylene production by suppressed as play activities of 1-aminocyclopropane-1-carboxylic acid (ACC) synthase in fruit. Also inhibited the activities of phospholipase and lipoxygenase which resulted in reduced degradation of phosphatidylcholine to phosphatidic acid and limited lipid peroxidation (Zhang *et al.*, 2022).

The scope of current investigation is to provide applicable solutions for the problem facing pear growers in Qaluob region i.e. low productivity in terms of quality and quantity by testing gibberellins and cytokinins foliar application.

MATERIALS AND METHODS

This study was conducted during three consecutive seasons 2020, 2021, 2022 in a private orchard at Qalyub, El-Qalyubia governorate Egypt. For each experimental season, 60 different 12 years old Le-Conte pear trees budded on *pyrusbetulaefolia* rootstock were used. Chosen trees were uniform as much as possible, planted at 5x5m in clay soil under flood irrigation. Conventional management practices previously recommended by the Egyptian ministry of Agriculture were adopted.. Each six trees were subjected to a single foliar treatment. Each tree acted as a replicate. Three replicates for each considered treatment were used for morphological determinations and the other three replicates were used for taking samples for chemical determinations the considered treatments were applied by hand sprayer at petal fall. The considered treatments were as follows;

1. Gulliver (1% CPPU) 1cm/L.
2. Gulliver 0.5 cm/L.
3. Gulliver 0.25 cm/L.
4. Gulliver 0.5 cm/L + GA_3 (10% gibberellic acid) 0.15 g/L.
5. Kinetin (0.004%) 1cm/L.
6. Kinetin 0.5 cm/L.
7. Kinetin 0.25 cm/L
8. Kinetin 0.5 cm/L + GA_3 (10% gibberellic acid) 0.15 g/L.
9. Benzyl adenine 0.0125 g/L.
10. Control (water sprayed).

Foreach of the considered seasons the following parameters were assessed:

Fruit set percentage: For each of the considered trees 4 branches with nearly same load of spurs around the circumference were chosen and labeled. Fruit setpercentage was calculated on the basis of initial number of flower as:

Fruit set % = (Total No. of fruitlets/Total No. of flowers) x 100

Fruit retention (%): Number of fruitlets/branch was counted and at harvest number of retained fruits/tree was counted too.

The percentage of fruit retention at harvest was calculated as follows:

Fruit retention percentage =(average No of retained fruits/average No. of fruitlets) x 100

Yield (Kg/tree):

At maturity according to El-Azzouni et al. (1975) average fruit weight of 10 fruits per replicate were measured and number of fruits per tree were counted and yield was estimated as follows: average fruit weight* number of fruits per tree

Yield attributes:

a) Physical attributes: At maturity, a representing sample of 20 fruits per tree were harvested from trees dedicated to sampling. The following characteristics were assessed Fruit weight (g.), fruit volume(cm^3), fruit length (cm.), width (cm.) and unpeeled fruit firmness (Lb. /$inch^2$) by Lfra texture analyzer.

a) **Chemical attributes:** Total soluble solids percentage (TSS %) were determined in fruit juice by Abbe hand refractometer. Total acidity percentage (TA %) as malic acid was determined in fruit juice according to A.O.A.C. (1995).

Vegetative growth attributes):-at growth cessation for each considered treeten of current season's shoots were selected at random from each replicate for determining the following parameters; average shoot diameter (cm) by using a vernier caliper, shoot length (cm) by using a ruler. Number of leaves/shoot, leaf area (cm^2) measured according to Bleasdale, 1978).

Chemical determinations:

a) Foliar macro-nutrients: On mid-August, after harvest a sample of fifty mature leaves were taken from the mid region of current year's shoots from trees dedicated for sampling of each replicate. Leaves were washed with tap water then with distilled water and oven dried at 50°C to constant weight. They were then ground, digested with sulphoric acid and hydrogen peroxide for the determination of N, P, K. Nitrogen percentage was estimated by microkjeldahl Gunning method (A.O.A.C. 1995). Phosphorus percentage was determined calorimetrically by hydroquinone method (Foster and Cornelia, 1967). Potassium percentage was estimated by flame photometer as Jackson (1973).

b) **Hormonal determination:** sample of fresh leaflets were taken for determination hormones IAA, GA+ and ABA was taken after two week of spraying the treatments to compare between them in its hormones content. The fractionated and determination by using (HPLC) according to the method described by (Wasfy and Orrin, 1975).

c) **Proteinfractions determinations**: samples from treated and untreated fresh young leaves were collected was taken after two week of spraying the treatments to compare between them in its total soluble protein was performed in the third season only according to the method of Laemmli (1970).

Economic feasibility study:

Cost/fed (LE) = Cost of sprayed material x number of tree / fed (169 tree).

Yield/fed (Ton) = Fruit yield kg/tree x No. of trees / fed (169 tree).

Income/fed (LE) total = Price of one kg pear in the farm x tree yield ton/fed

The price of one kg pear = was (7, 10 and 8 LE) for the three seasons receptively the price of farm gate before the offer in marketing.

Net profit = (treatments cost + management practices cost) – total selling price

Horticultural practices cost = 20000 LE/Fed.

The amount of solution needed to cover the trees per feddan = 1127 liters of water

Statistical analysis: The experiment was arranged as a randomized complete blocks design and the collected data were statistically analyzed according to Snedecor and Cochran (1990). Means of treatments were compared using least significant difference (LSD) test at $P < 0.5$.

RESULTS

The results are in Table 1, show that compared with control all applied treatments significantly increased fruiting in terms of percentages of fruit set and retention in addition to the yield the highest significant effect was attributed to CPPU (1%) 1cm/L at petals fall **(**Fig 1 and 2).This was true for the 3 experimental seasons**.**

Table (1): Effect of conducted treatments on fruiting attributes.

Treatments	Fruit set %			Fruit retention %			Yield (kg/tree)		
	2020	2021	2022	2020	2021	2022	2020	2021	2022
CPPU 1cm/L	9.89 A	4.39 A	13.47 A	24.53 A	29.70 A	15.52 A	145 A	64.20 A	93.23 A
CPPU 0.5 cm/L	6.80 C	2.84 BCD	9.42 C	17.73 C	22.38 C	11.38 C	88.87 C	40.13 CD	67.01 C
CPPU 0.25 cm/L	4.99 D	1.99 FG	6.82 E	15.50 D	19.38 E	9.68 E	60.40 E	30.47 F	43.10 G
CPPU 0.5 cm/L +GA_3	6.47 C	2.69 CD	6.50 E	17.40 C	21.59 CD	11.00 C	82.33 CD	35.20 E	62.17 D
Kinetin (0.004%)1cm/L	7.58 B	3.10 B	10.33 B	20.28 B	25.35 B	13.00 B	101.30 B	50.11 B	71.00 B
Kinetin 0.5 cm/L	6.44 C	2.58 D	9.05 C	17.90 C	22.38 C	11.46 C	90.32 BC	40.63 CD	63.23 D
Kinetin 0.25 cm/L	5.58 D	2.30 E	8.35 D	16.97 C	21.31D	10.47 D	81.45 CD	37.37 DE	47.72. F
Kinetin 0.5 cm/L +GA_3	7.00 BC	2.92 BC	9.52 C	17.67 C	21.93 CD	11.22 C	89.33 C	43.08C	71.07 B
Benzyl adenine	5.31 D	2.21 EF	6.50 E	15.21 DE	19.16 E	9.35 E	72.30 D	33.97 E	51.07 E
Control	4.22 E	1.83 G	5.53 F	14.23 E	17.42 F	8.74 F	48.54 F	24.00 G	32.06 H
L S D	0.63	0.264	0.64	1.05	0.953	0.53	11.17	3.29	2.63

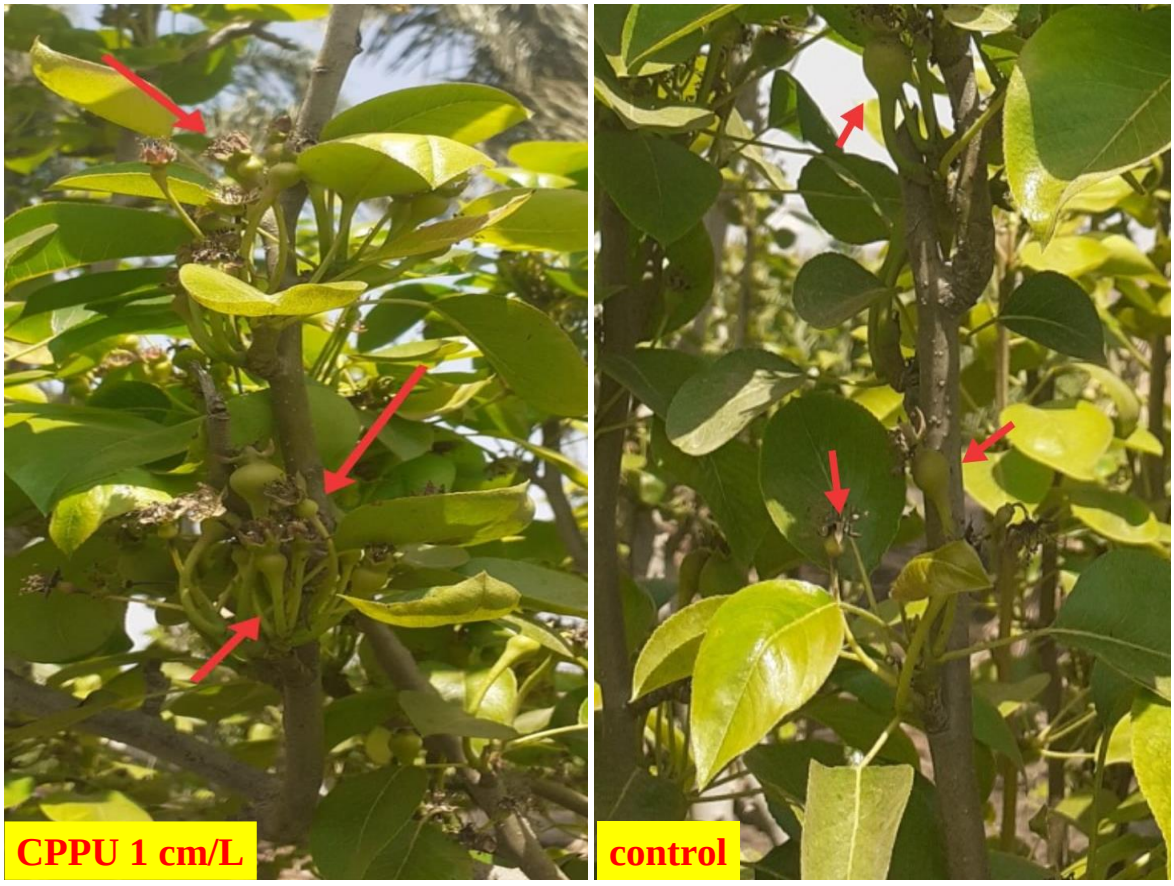

Fig (1): Effect of CPPU treatment on fruit set compared to control

Fig (2): Effect of CPPU treatment on yield compared to control

With respect to fruit weight size and dimensions (Table 2, 3) all considered treatments induced significant increases these, compared to the control during the three experimental seasons. Highest significant results were due to spraying Kinetin 0.5 cm/L + GA_3at petals fall (Fig 3).

Table 2 - Effect of treatments on fruit weight and fruit size.

Treatments	Fruit weight (g)			Fruit size (cm3)		
	2020	2021	2022	2020	2021	2022
CPPU 1cm/L	154 f	135 g	154 e	155 f	127 g	142 g
CPPU 0.5 cm/L	185 c	153 f	174 d	187 cd	155 f	176 d
CPPU 0.25 cm/L	157 ef	163 e	148 f	148 g	154 f	142 g
CPPU 0.5 cm/L +GA_3	199 ab	176 d	175 d	198 b	177d	176 d
Kinetin (0.004%)1cm/L	189 bc	194 b	186 c	191 c	194 b	187 c
Kinetin 0.5 cm/L	183 c	186 c	221 b	184 d	188 c	223 b
Kinetin 0.25 cm/L	166 de	174 d	170 d	154 f	160 e	155 f
Kinetin 0.5 cm/L +GA_3	208 a	212 a	247 a	210 a	214 a	249 a
Benzyl adenine	172 d	163 e	170 d	162 e	156 f	160 e
Control	123 g	127 h	141 g	113 h	122 h	140 g
L S D	9.78	3.83	5.87	4.7	3.81	4.12

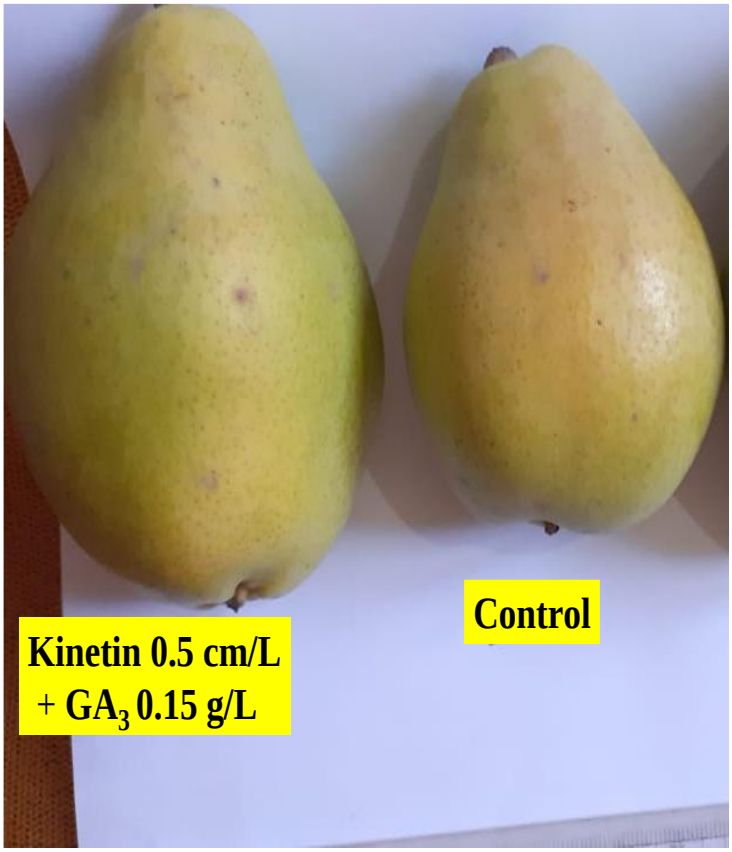

Fig (3): Effect of Kinetin + GA_3treatment on fruitsize compared to control.

Table (3): Effect of treatments on fruit length and fruit width.

Treatments	Fruit length (cm)			Fruit width (cm)		
	2020	2021	2022	2020	2021	2022
CPPU 1cm/L	7.69 e	7 .00 d	7.20 d	5.89 ef	5.27 f	6.23 bc
CPPU 0.5 cm/L	8.56 bc	7.23 d	7.73 cd	6.64 bc	6.50 c	6.47 bc
CPPU 0.25 cm/L	7.88 de	7.10 d	7.37 d	6.10 de	5.80 de	6.33 bc
CPPU 0.5 cm/L +GA_3	8.54 bc	8.30 b	8.00 c	6.80 ab	6.77 bc	6.33 bc
Kinetin (0.004%)1cm/L	8.78b	8.53 b	8.00 c	6.62 bc	6.93 b	6.70 b
Kinetin 0.5 cm/L	8.65bc	7.90 c	8.83 b	6.60 bd	6.57 c	7.30 a
Kinetin 0.25 cm/L	8.08 de	7.30 d	7.30 d	6.26 cde	6.10 d	5.90 c
Kinetin 0.5 cm/L +GA_3	9.27 a	9.60 a	9.80 a	7.20 a	7.60 a	7.80 a
Benzyl adenine	8.29 cd	7.10 d	8.07 c	6.44 bcd	567 e	6.50 bc
Control	6.93 f	5.70 e	7.37 d	5.63 f	5.20 f	6.20 bc
L S D	0.42	0.38	0.51	0.43	0.32	0.54

Highest unpeeled fruit firmness was attained by control fruits. Spraying Kinetin 0.5 cm/L + GA_3at petals fall markedly reduced the unpeeled fruit firmness compared with the remaining treatments and control, this was true for the 3 considered seasons. (Table 4).

Kinetin at 0.5 cm/L alone or combined with GA_3resulted in increasing the percentage of juice TSS compared to the rest of the treatments, especially the treatment of

CPPU 1cm/L, which recorded the lowest percentage of TSS during the three study seasons (Table 4).

Spraying Benzyl adenine at petals fall resulted in obviously the highest percentage of juice acidity compared with control and remaining treatments in the 3 seasons. Whereas Kinetin at 0.5 cm/L +GA_3 induced significantly the least percentage (Table 4).

Table (4): Effect of treatments on fruit firmness, TSS and acidity.

Treatments	Fruit firmness (Ib/inch2)			TSS%			Acidity%		
	2020	2021	2022	2020	2021	2022	2020	2021	2022
CPPU 1cm/L	15.91 a	19.76 ab	20.76 b	10.50 e	13.00 e	16.30 c	0.20 cd	0.30 ab	0.25 abc
CPPU 0.5 cm/L	14.67 b	18.75 abcd	18.62 def	11.57 bcd	14.32 c	17.33 ab	0.23 bc	0.29 ab	0.21 bc
CPPU 0.25 cm/L	15.00 ab	19.67 ab	19.41 cde	11.70 bcd	14.43 bc	17.20 abc	0.25 bc	0.33 ab	0.21 bc
CPPU 0.5 cm/L +GA_3	13.50 c	17.47 e	18.39 ef	11.27 cde	15.17 a	16.60 bc	0.25 bc	0.26 ab	0.24 bc
Kinetin (0.004%)1cm/L	15.00 ab	18.50 cde	20.23 bc	11.67 bcd	14.92 ab	16.60 bc	0.20 cd	0.26 ab	0.24 bc
Kinetin 0.5 cm/L	13.63 c	18.72 bcd	18.91 def	12.20 ab	15.27 a	17.53 ab	0.26 b	0.26 ab	0.29 ab
Kinetin 0.25 cm/L	14.92 ab	18.00 de	20.41 bc	12.03 abc	13.50de	16.80 abc	0.24 bc	0.26 ab	024 bc
Kinetin 0.5 cm/L +GA_3	13.23 c	16.25 f	18.17 f	12.73 a	15.10 a	17.60 a	0.16 d	0.24 b	]0.20 c
Benzyl adenine	14.00 bc	19.36 abc	19.50 cd	11.03 de	13.75 d	17.33 ab	0.37 a	0.35 a	0.33 a
Control	15.71 a	19.35 a	22.04 a	11.07 de	14.47 bc	16.33 c	0.26 b	0.32 ab	0.29 ab
L S D	0.31	1.01	0.98	0.77	0.53	0.85	0.05	0.09	0.076

All treatments resulted in shorter shoots when compared with water treated control which attained the longest shoots. Shortest shoots were dedicated to the Gulliver (CPPU) 1cm/L treatment at petals fall (table 5).

During the three seasons, spray CPPU0.5 cm/L +GA_3 at petal drop showed the best results for increasing the diameter of the shoot compared to all treatments and the control, while the least diameter of the shoot was gave with the treatment of CPPU 1cm/L at the same stage (Table 5).

Table (5): Effect of treatments on shoot length and shoot diameter.

Treatments	Shoot length(cm)			Shoot diameter (cm)		
	2020	2021	2022	2020	2021	2022
CPPU 1cm/L	21 d	29 e	37 f	0.60 e	0.74 d	0.80 d
CPPU 0.5 cm/L	31 c	41 d	49 cde	0.69 d	0.82 bc	0.85 cd
CPPU 0.25 cm/L	36 b	44 bc	52 bc	0.67 d	0.85 b	0.92 b
CPPU 0.5 cm/L +GA_3	38 b	42 cd	51 bcd	0.93 a	1.01 a	1.06 a
Kinetin (0.004%)1cm/L	35 b	40 d	47 e	0.77 bc	0.82 bc	0.88 bc
Kinetin 0.5 cm/L	38 b	43.72 c	49 cde	0.77 bc	0.83 b	0.90 bc
Kinetin 0.25 cm/L	37 b	41 d	50 b-e	0.73 cd	0.77 cd	0.87 bc
Kinetin 0.5 cm/L +GA_3	37 b	44 c	48 de	0.69 d	0.77 cd	0.91 bc
Benzyl adenine	37 b	46 b	53 b	0.73 cd	0.80 bc	0.87 bc
Control	44 a	50.34 a	58 a	0.82 b	0.86 b	1.01 a
L S D	2.68	2.04	3.28	0.053	0.054	0.53

Application of CPPU0.5 cm/L or CPPU0.5 cm/L +GA_3 was the best treatment in terms of significantly increasing the number of leaves per shoot compared to the rest of the treatments and the control, with respect to the effect of the conducted treatments on leaf area, it is evident that control trees carried the largest leaves whereas, marked decreases in leaf areas were attributed to treatments, (Table 6).

Table (6): Effect of treatments on number of leaves and leaf area.

Treatments	No. of leaves			Leaf area(cm^2)		
	2020	2021	2022	2020	2021	2022
CPPU 1cm/L	15.00 b	18.33 abc	22.00bc	26.00 d	34.13 bc	38.00 b
CPPU 0.5 cm/L	18.00 a	20.00 a	23.00ab	29.50 b	32.97 cd	36.00 cd
CPPU 0.25 cm/L	15.00 b	16.00 de	21.00 cd	27.00 cd	31.00 de	34.00 e
CPPU 0.5 cm/L +GA_3	18.00 a	18.67 abc	24.00 a	27.40 c	30.33 e	36.00 b-d
Kinetin (0.004%)1cm/L	15.00 b	14.47 e	19.00 e	29.83 ab	33.00 cd	37.00bc
Kinetin 0.5 cm/L	14.00 b	16.00 de	19.00 e	29.30 b	35.33 ab	38.00 b
Kinetin 0.25 cm/L	17.00 a	19.00ab	22.00 b-d	27.00 cd	30.83 e	34.00 e
Kinetin 0.5 cm/L +GA_3	15.00 b	17.00 cd	19.00 e	29.37 b	33.97 bc	37.00bc
Benzyl adenine	15.00 b	17.00 cd	19.00 e	26.61 cd	33 50 bc	35.00 de
Control	14.33 b	18.00bc	20.00 de	31.17 a	37.00 a	41.00 a
L S D	1.59	1.62	1.68	1.35	1.95	1.46

The results in table 7 showed a decrease in the leaves nitrogen content of all treatments compared to the control. All treatments gave increases in the potassium and phosphorus leaves content compared to the control. The best treatments were CPPUspray 1 cm/L compared to the rest of the treatments and control (Table 7).

Table(7): Effect of treatments on nitrogen, potassium and phosphorus leaves content.

Treatments	N %		P %		K %	
	2021	2022	2021	2022	2021	2022
CPPU 1cm/L	1.40 f	1.94 f	0.420 a	0.440 a	2.30 a	2.40 a
CPPU 0.5 cm/L	1.90 c	2.00 de	0.360 e	0.410 b	2.10 c	2.20 b
CPPU 0.25 cm/L	1.81 d	2.50 c	0.370 d	0.310 e	2..00 d	1.80 d
CPPU 0.5 cm/L +GA_3	1.80 d	2.40 c	0.380 c	0.380 c	1.90 e	2.10 bc
Kinetin (0.004%)1cm/L	1.60 e	2.10 e	0.390 b	0.410 b	2.20 b	2.20 b
Kinetin 0.5 cm/L	1.80 d	2.10 e	0.390 b	0.410 b	2.20 b	2.00 c
Kinetin 0.25 cm/L	2.10 b	2.70 ab	0.390 b	0.340 d	2.10 c	2.00 c
Kinetin 0.5 cm/L +GA_3	1.60 e	1.80 ef	0.380 c	0.390 bc	2.20 b	2.00 c
Benzyl adenine	1.81 d	2.00 de	0.370 d	0.400 b	2.00 d	2.20 b
Control	2.20 a	2.85 a	0.340 f	0.350 d	1.36 e	1.16 e
L S D	0.09	0.14	0.009	0.019	0.09	0.19

Table (8): Effect of treatments on leaflets GA_3, IAA and ABA content.

Treatments	GA_3 (mg/100g)	IAA (mg/100g)	ABA (mg/100g)
	2022	2022	2022
CPPU 1cm/L	1.95	3.93	0.56
CPPU 0.5 cm/L	2.18	2.82	1.02
CPPU 0.25 cm/L	1.41	0.11	1.67
CPPU 0.5 cm/L +GA_3	1.07	2.7	0.76
Kinetin (0.004%)1cm/L	1.67	3.59	0.6
Kinetin 0.5 cm/L	1.3	3.01	1.13
Kinetin 0.25 cm/L	1.54	0.73	0.64
Kinetin 0.5 cm/L +GA_3	4.33	3	0.76
Benzyl adenine	1.56	0.17	1
Control	0.77	0.06	1.87

Clear increments in both leaf GA_3 and IAA were attributed to conducted treatments. Highest content of leaf GA_3 was due to Kinetin 0.5 cm/L +GA_3 followed by CPPU 0.5

cm/L and then CPPU 1cm/L.concerning with leaf content of IAA highest content was due to CPPU 1cm/Lfollowed by Kinetin 1cm/L. As for leaf content of ABA it was reduced by all treatments to reach its' minimal value due to CPPU 1cm/L (Table 8).

The protein banding profiles of the 10 treatments as revealed by SDS-PAGE are illustratedin (Fig 4) and (Table 9). The total number of bands was 10 with molecular weights ranging from 20 to 394KDa. The highest number of protein bands was 10, detected in CPPU 1cm/L and Gulliver 0.5 cm/L, while the lowest number of bands was 7, identified in CPPU 0.25 cm/L and Kinetin 0.25 cm/L, while Control, CPPU 0.5 cm/L + GA_3 and Benzyl adenine recorded 9 bands.

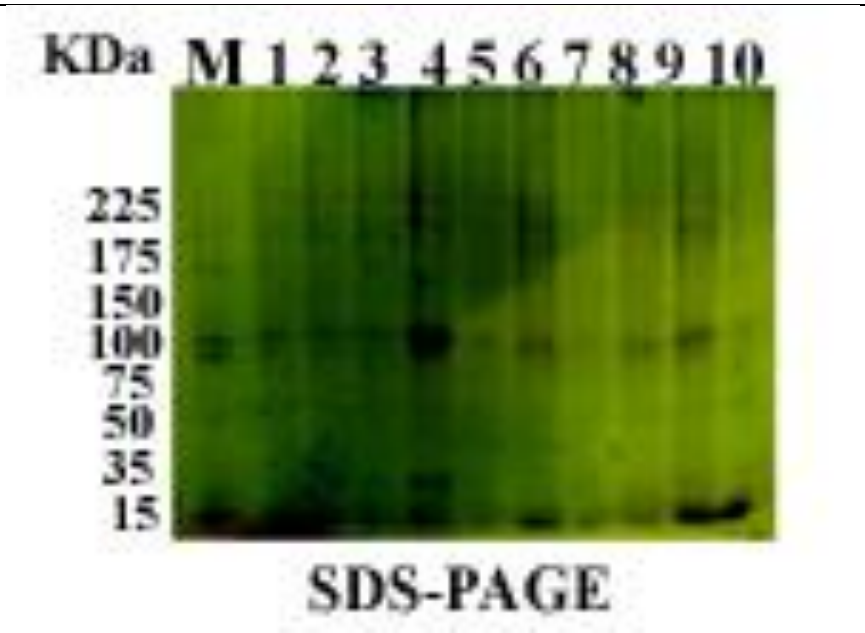

Fig 4- SDS-Protein electrophoresis (1-10 treatments):
Arrangement of treatments in protein separation:
1) CPPU 1cm/L (2) CPPU 0.5 cm/L (3) CPPU 0.25 cm/L (4) CPPU 0.5 cm/L +GA_3 (5) Kinetin (0.004%)1cm/L (6) Kinetin 0.5 cm/L (7) Kinetin 0.25 cm/L (8) Kinetin 0.5 cm/L +GA_3 (9)Benzyl adenine (10) Control

Table (9). Effect of treatments on protein electrophoretic banding patterns of pear leaves

Band No	M.W Kda	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	**394**	1	1	1	1	1	1	1	1	1	1
2	**360**	1	1	1	1	1	1	1	1	1	1
3	**305**	1	1	0	1	1	1	1	1	1	1
4	**245**	1	1	0	0	0	0	0	0	0	1
5	**177**	1	1	1	1	1	1	1	1	1	1
6	**90**	1	1	1	1	1	1	1	1	1	1
7	**74**	1	1	1	1	0	1	1	1	1	1
8	**52**	1	1	1	1	1	1	0	1	1	1
9	**26**	1	1	0	1	1	0	0	0	1	0
10	**20**	1	1	1	1	1	1	1	1	1	1
Total		10	10	7	9	8	8	7	8	9	9

Table (10). Feasibility study for treatments applied on of "Le-Conte" pear in 2020, 2021 and 2022 seasons.

Treatments	*Cost/fed (LE)			**Yield/fed (Ton)			***Income/fed			****Net profit(LE)		
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
CPPU 1cm/L	3947	3947	3947	24.505	10.85	15.756	171535	10850	126047	147588	84551	102100
CPPU 0.5 cm/L	1972	1972	1972	15.019	6.782	11.325	105133	6782	90598	83161	43873	68626
CPPU 0.25 cm/L	986	986	986	10.208	5.149	7.284	71453	5149	58271	50467	27547	37285
CPPU 0.5 cm/L + GA_3	2254	2254	2254	13.914	5.949	10.507	97396	5949	84054	75142	35541	61800
Kinetin 1cm/L	564	564	564	17.12	8.469	11.999	119838	8469	95992	99274	60739	75428
Kinetin 0.5 cm/L	282	282	282	15.264	6.867	10.686	106849	6866	85487	86567	44718	65205
Kinetin 0.25 cm/L	141	141	141	13.765	6.316	8.065	96355	6316	64517	76214	39208	44376
Kinetin 0.5 cm/L +GA_3	705	705	705	15.097	7.281	12.011	105677	7281	96087	84972	4885	75382
Benzyl adenine	3100	3100	3100	12.219	5.741	8.631	85531	5741	69047	62431	33462	45947
Control	Water spray			8.203	4.056	5.418	57423	4056	43345	37423	20560	23345

***** Cost of sprayed material for one tree x number of additions x number of tree / fed (169 tree)

****** Fruit yield kg/tree x No. of trees / fed (169 tree).

******* Price of one kg pear in the farm x tree yield ton/fed

The price of one kg pear = (7, 10 and 8 LE) for the three seasons receptively the price of farm gate before the offer in marketing.

********Net profit = (treatments cost + management practices cost) – total selling price.

Feasibility study for treatments:

This study showed that spraying Gulliver (CPPU) 1cm/Lduring the petals falling stage gave the highest production rate per feddan in tons, and it also gave the highest income per feddan and the highest economic return compared to the rest of the treatments during the three years of the study (Table 10).

DISCUSSION

Excessivevegetative growth leads to high competition with fruiting thus leading to poor production trees of quantity and quality in pear trees (Plavcová, *et al*.,2022). So, the untreated trees with high nitrogen and with abundant vegetative growth gave less productivity because of competition between abundant vegetative growth and fruiting.

In this study, CPPU 1cm/L at petals fallresulted in the highest content of indole acetic Acid, potassium, phosphorus leaves content and the lowest content of abscisic acid, nitrogen leaves content. Moreover, the highest number of protein bands this change in protein composition is evidence for the change in gene expression with increasing transcription ratethus leading to statistically the best increase in fruit set, fruit retention percentages and yield on the other hand the least vegetative growth attributes compared to the control during the three seasons of the investigate. CPPU inhibits oxidation of cytokinins (Mok, and Mok 2001). Its great role in activating the biosynthesis of proteins, RNA and DNA (Nickell.1985).One of its most important effects is that, it is characterized by quick cell division, increasing their number, enlarging their size, delaying aging, improving photosynthesis, increasing the single and total leaf area, and extending the life of leaves in food processing (Flaishmanet al., 2001). In addition to, the production of more hyperhydric (a physiological malformation that results in excessive hydration, low lignification, impaired stomatal function and reduced mechanical strength of tissue culture-generated plant) shoots (Kadota and Niimi, 2003).Rate of endosperm cell division is closely associated with cytokinin level in endosperm (Yang et al., 2002) while cytokinins regulate various aspects of plant growth and development. For their positive

effects on branching, delaying of senescence, nutrient remobilisation, transport and protein synthesis in fruit growth, fruit parthenocarpy, increase the ability of the fruit to attract carbohydrates (Koprna et al., 2016).

Many researchers showed that foliar spraying of fruit trees with CPPU increase fruit set, decrease fruit drop, improve the yield and its' attributes (Guirguisetal., 2003; Faissaletal., 2007 and Fathi et al., 2013) on Le-Conte pear; (Harhashetal. 2017) on "Anna" Apple (Guirguisetal., 2010; Stem etal., 2006; Fathi et al., 2011) on " Costata" Persimmon; (Ennab and Abo Ogiela, 2019) on "Kelsey" Plum, and (Itaietal., 1995) BA, CPPU combination on "Diospyros" kaki.

In this study, spraying Kinetin 0.5 cm/L + GA_3 treatment at petals fall gave the highest content of gibberellic acid resulting in the highest significant fruit weight, fruit size, fruit length and fruit diameter compared to the control during the three study years (Table 2, 3). GA_3 has the same effect for acceleration the cell enlargement and improving fruit quality which was reflected on yield and fruit size (El Salhy et al., 2009 and Hajam et al., 2018). Gibberellic acid (GA_3) affects fruit setting, abscission, cell elongation, apical dominance and photoperiod (Aboutalebi and Beharoznam, 2006: Nafea et al., 2015). Mode of action for GA_3: The first is that GA_3 intensifies an organ ability to function as a nutrient sink (Gilani, 2021) by the enhancement of phloem unloading or/and metabolism of carbon assimilates in pear fruit (Zhang et al. 2005). The second action is the faculty of GA_3 to rise the synthesis of IAA in plant tissues(Al-Asadiand Resan 2021) which delays the formation of separation layerthus enhancing fruit retention. The third one involves accelerating synthesis of hydrolytic enzymes as amylase in the aleurone layer of seeds (Addicott and Addicott, 1982). Exogenous kinetin significantly increase rate of endosperm cell division (Yang et al., 2002). It's increasing fruit set, yield, roots, cell division and differentiation in 'Rocha' pears (Muniz, 2014). Kinetin + GA combination sprayed during the flowering period in 'Rocha' pears showed increases in fruit set and yields (Muniz, 2014; Carra et al., (2021).

The study showed that the treatments reduced the nitrogen content of the leaves and the vegetative growth measurements compared to the control, which led to an increase in the production of the treatments as a result of the lack of consumption and depletion of food to produce a vegetative total above the limit, which was directed to fruitful production and quality (Plavcová, et al.,2022).

CONCLUSION

It is possible to control excessive vegetative growth and direct the trees towards more fruiting in terms of quantity and quality by using the foliar spraying of CPPU 1 cm/L during the petals fall stage.In order to reach the best fruit size and fruiting characteristics, the trees should be treated with Kinetin at 0.5 cm/L +GA_3at the same stage. So, we recommend pear growers to foliar spraying of Gulliver (1% CPPU) 1 cm/L during the petals fall stage achieving higher yield and higher net profit per feddan.

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تأثير الرش الورقى السيتوكينين الفنيل يوريا والكاينتين والبنزيل ادينين على تساقط وجودة ثمار الكمثرى الليكونت

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تتمثل المشكلة الرئيسية لصنف الكمثرى الليكونت فى الحجم الكبير للنمو الخضري للأشجار، ويرجع ذلك إلى الاشجار مطعومة على أصل البتشيليفوليا الذى يعمل على تشجيع النمو الخضرى للاشجار المطعومة عليه، وكذلك إلى أرتفاع خصوبة التربة والري بالغمر للتربة في غالبية مناطق الوادي. وبالتالي يؤدي إلى التقليل من الإنتاجية ونوعية رديئة للثمار. ولعمل على التوازن بين النمو الخضرى والثمرى في أشجار الكمثرى باستخدام منظمات نموالسيتوكينينات.

والتي تستخدم بالرش الورقى عند تساقط البتلات على النحو التالي؛ جواليفر 1، 0.5 و0.25 سم/لتر وجواليفر 0.5 سم/لتر + حمض الجبريليك 0.15 جم/لتر، كينتين 1؛ 0.5 و0.25 سم/لتر وكينتين 0.5 سم/لتر + حمض الجبريليك 0.15 جم/لتر، بنزيل أدينين 0.0125 جم/لتر. والقياسات المستخدمة كالتالي؛النسبة المئوية للعقد، النسبة المئوية للثمار المتبقية، المحصول (كجم/شجرة)، الخصائص الثمرية (وزن الثمرة، وصلابة الثمرة، ونسبة المواد الصلبة الذائبة ونسبة الحموضة للثمرة)، النمو الخضري، التحليل الكيميائي (محتوى الأوراق من النيتروجين والفوسفور والبوتاسيوم) والهرمونات (حمض الجبريليك،حمض الاندول اسيتك وحامض الابسيسك) والتفريد الكهربى للبروتين.

اعطى الرش بالجوليفر 1سم/لترعند تساقط البتلات إلى أفضل النتائج بزيادة نسبة العقد وزيادة الثمار المتبقية وكمية المحصول والحد من النمو الخضرى وزيادة محتوى الهرمونى من حامض إيندول أسيتيك وتقليل المحتوى الهرمونى حامض الابسيسيك وزيادة عدد حزم البروتين وأعلى معدل صافى ربح للفدان.

أعطت المعامله بالكينيتين 0.5 سم/ لتر+ حامض الجبريلك عند تساقط البتلات إلى أفضل وزن للثمار وحجم الثمار وطول الثمار وعرض الثمارومحتوى حمض الجبريليك مقارنة بالأشجار الغير معاملة خلال ثلاث مواسم الدراسة.

الكليمات الدالة: اشجارالكمثرى - صنف الليكونت – منظمات النمو- النمو الخضرى – والنمو الثمرى.