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Effect of CPPU, GA, Milagrow and Pepton on Yield and Quality of "Le-Conte" Pear Trees

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THE PRESENT study was conducted during 2011 and 2012 seasons on "Le-Conte" pear trees (*Pyrus communis* X *Pyrus pyrifolia*). Trees were 7-year-old, budded on *Pyrus communis* rootstock and grown on calcareous soil under flood irrigation system in a private orchard located at Borg El-Arab region, Alexandria Governorate. Thirty nine trees were chosen and planted at 5 x 5 m apart. Thirteen treatments were carried out in this study; CPPU, GA3, Milagrow and Pepton were sprayed at full bloom or at fruit set.

Results showed that spraying with 10 or 15 ppm CPPU at fruit set recorded the highest values of yield and its monetary value, fruit set, fruit weight, fruit size and TSS, and the lowest values of fruit firmness and acidity. While, control and spraying with Milagrow at full bloom recorded the lowest values of yield, fruit set, fruit weight, fruit size and TSS, and the highest values of fruit firmness and acidity in both seasons.

"Le-conte" is the main pear cultivar, widely grown in Egypt grafted on the main rootstock, *P. communis* that shows high susceptibility to pear blights (Reimer, 1950). The total harvested area of pears declined sharply during the last decades due to fire blight infection as it dropped from 10990 feddans in 1999 to 6960 feddans in 2005. However, the area started to increase gradually as a result of treatments against fire blight as it reached 10514 feddans in 2010 according to statistics of the Ministry of Agriculture.

Sittofex (CPPU) is a synthetic cyto-kinin N-(2-chloro-4-pyridmyl)-Nureaphenyl) is a product of ALZ Chem-Germany, Trans Fridge Inter., Comp., CPPU with different concentrations enhanced cell division, increased cell size, increased fruit weight, size and fruit yield. Furthermore, application of the abovementioned growth regulator improved the most fruit properties (Kabeel, 1999 on persimmon; Marwad 2001 on grapes; Guirguis *et al*., 2003 and Kabeel and Fawaaz, 2005 on pear trees).

GA_3 significantly increased persimmon fruit set, firmness, colour and T.S.S. (El-Fakharani *et al*., 1990 and Hasegawa *et al*., 1991).

Milagrow (Brassinosteroids, BRs) has been found to stimulate cell division and elongation, flower bud differentiation, carbohydrate assimilation and ATP

activity, subsequently improved vegetative growth, enhanced physiological status and directed trees to earlier harvest as well as increased fruit yield and quality (Clause, 1996, Wang *et al*., 2004, Mussig, 2005, Gomes *et al*., 2006; Symons *et al*., 2006 and Gabr *et al*., 2011).

Amino acids were used as trade mark (Pepton) constitute of total amino acids, organic nitrogen and potassium oxide. Gehan *et al*., (2009) found that Pepton treatment resulted in the best yield and its components, improved the physical and chemical characteristics of Red Globe grapes in comparison with the control.

The aim of this investigation is to study the effect of CPPU, GA_3, Milagrow and Pepton when sprayed at full bloom or fruit set on yield and quality of "Le-Conte" pear trees.

Materials and Methods

The present study was conducted during 2011 and 2012 seasons on "Le-Conte" pear trees (*Pyrus communis* X *Pyrus pyrifolia*). Trees were 7-year--old, budded on *Pyrus communis* rootstock and grown on calcareous soil under flood irrigation system in a private orchard located at Borg El-Arab region, Alexandria Governorate. Thirty nine trees were chosen and planted at 5 x 5 m apart. Thirteen treatments were carried out in this study Each treatment was replicated three times (one tree for each replicate). CPPU (N-(2-chloro-4-pyridinyl)-N-phenylurea), GA_3, Milagrow and Pepton were sprayed at full bloom or at fruit set on pear trees at the following concentrations:

- Spraying Milagrow at 50 ppm at full bloom
- Spraying GA_3 at 20 ppm at full bloom
- Spraying CPPU at 5 ppm at full bloom
- Spraying CPPU at 10 ppm at full bloom
- Spraying CPPU at 15 ppm at full bloom
- Spraying Peptone at 2000 ppm at full bloom
- Spraying Milagrow at 50 ppm at fruit set
- Spraying GA_3 at 20 ppm at fruit set
- Spraying CPPU at 5 ppm at fruit set
- Spraying CPPU at 10 ppm at fruit set
- Spraying CPPU at 15 ppm at fruit set
- Spraying Peptone at 2000 ppm at fruit set
- Spraying control with tap water

Four main branches representing all tree sides were chosen at random and labeled before spraying. At fruit set and picking date, samples of five fruits from each replicate were taken to determine the following characteristics:

- Fruit set (%)
- Retained fruits (%)
- Number of fruits/tree
- Yield/tree (kg)

- The monetary value (L.E.) was estimated using a farm-gate price of LE 1.5/kg for fruit weighed < 90 g, LE 2.0/kg for fruit weighed 90-110g and LE 2.5/kg for fruit weighed > 110g.
- Fruit firmness (lb/inch^2) was measured using the Pentrometer (Magness and Taylor 1925).
- Fruit shape index (fruit length/fruit diameter)
- Fruit weight (gm)
- Fruit size (cm^3)
- Total soluble solids (%) of fruit juice was measured using hand Refractometer.
- Total acidity (%) was measured as mg Malic acid/100 g juice fresh weight (A.O.C.A., 1990).

Statistical analysis

All obtained data were statistically analyzed using complete randomized block design (Steel and Torrie 1980). Least significant difference (LSD) test at 5% was used for comparison between means of the studied treatments.

Results and Discussion

Fruit set

As shown in Table 1 , it is appear that spraying with CPPU, GA_3, Milagrow and Pepton at full bloom or at fruit set had positive effect on fruit set than the control in the both seasons. It was found that spraying with 10 ppm CPPU at fruit set recorded the highest percentage of fruit set followed in a descending order by spraying with 15 ppm then 5 ppm CPPU at fruit set, whereas, the lowest percentage were obtained from the control and spraying with Milagrow at full bloom in the both seasons of the study.

Retained fruits

Data in Table 1, revealed that spraying with CPPU, GA_3, Milagrow and Pepton at full bloom or fruit set enhanced the retained fruits percentage in both seasons. The maximum percentages were recorded on trees sprayed with 10 ppm CPPU at fruit set followed in a descending order by spraying with 15 ppm CPPU at fruit set, while, the minimum percentages were obtained from the control and spraying with Milagrow at full bloom in the both seasons.

Number of fruits/tree

As shown in Table 1, it is appeared that spraying with CPPU, GA_3, Milagrow and Pepton at full bloom or at fruit set had positive effect on number of fruits/tree than control in both seasons. It was found that spraying with 10 ppm CPPU at fruit set recorded the highest values of number of fruits/tree (497 and 427) followed in a descending order by spraying with 15 ppm CPPU at fruit set (419 and 413), whereas, the lowest values were obtained from control (248 and 197) and spraying with Milagrow at full bloom in the both seasons, respectively. These results are in line with those obtained by El-Barkooky (1985) Greene (1989) on apple, Jindal and Sharma (1986) on plum, Biasl *et al*., (1991), Lowes and Woolley (1992) on Kiwi; Kabeel (1999) on persimmon and Guirguis *et al*., (2003) on pear trees.

TABLE 1. Effect of different treatments on fruit set (%), retained fruits (%) and number of fruits/tree.

Treatments	Fruit set (%)		Retained fruits (%)		Number of fruits/tree	
	2011 season	2012 season	2011 season	2012 season	2011 season	2012 season
Milagrow at 50 ppm at full bloom	9.68	8.33	9.34	8.03	249	200
GA_3 at 20 ppm at full bloom	10.11	8.06	9.75	7.77	329	244
CPPU at 5 ppm at full bloom	18.71	14.87	21.76	17.30	408	308
CPPU at 10 ppm at full bloom	19.35	16.97	17.19	15.08	402	388
CPPU at 15 ppm at full bloom	25.18	22.04	20.43	17.88	411	372
Peptone at 2000 ppm at full bloom	13.29	8.93	9.59	6.45	327	227
Milagrow at 50 ppm at fruit set	29.22	4.60	21.36	3.36	294	260
GA_3 at 20 ppm at fruit set	21.91	19.52	20.03	17.85	360	342
CPPU at 5 ppm at fruit set	32.70	27.96	19.38	16.57	414	404
CPPU at 10 ppm at fruit set	41.02	31.63	40.72	31.40	497	427
CPPU at 15 ppm at fruit set	39.56	28.17	28.22	20.10	419	413
Peptone at 2000 ppm at fruit set	25.58	10.54	21.82	8.99	352	205
Control (without treatment)	9.40	8.12	6.80	5.87	248	197
LSD at (0.05)	3.92	4.49	7.68	8.79	60	47

Yield/tree (kg)

Data in Table 2 revealed that spraying with CPPU, GA_3, Milagrow and Pepton at full bloom or at fruit set had better effect on yield/tree in both seasons. The maximum values were recorded on trees sprayed with 10 ppm CPPU at fruit set (104.10 and 99.25kg) followed in a descending order by spraying with 15 ppm CPPU at fruit set, while, the minimum values were obtained from the control (42.44 and 33.18kg) and spraying with Milagrow at full bloom in both seasons. These results are in agreement with Jindal and Sharma (1986) on plum,

Biasl *et al*. (1991), Lowes and Woolley (1992) on Kiwi, Kabeel (1999) on persimmon and Guirguis *et al*. (2003) on pear trees.

The monetary value of yield

As shown in Table 2, it is appeared that spraying with CPPU, GA_3, Milagrow and Pepton at full bloom or at fruit set had positive effect on the monetary value of the pear yield in the both seasons. It was found that spraying with 10 ppm CPPU at fruit set recorded the highest values of the monetary value of yield (192.38 and 222.98 L.E.) followed in a descending order by spraying with 15 ppm CPPU at fruit set. Whereas, the lowest values were obtained from control (125.13 and 60.08 L.E.) and spraying with Milagrow at full bloom in both seasons. However, Abou Grah, *et al*. (2009) has reported the same trend.

Fruit firmness

Data in Table 3 revealed that spraying with CPPU, GA_3, Milagrow and Pepton at full bloom or at fruit set induced more suitable fruit firmness in the both seasons. All treatments recorded the lowest values, while, the maximum values were obtained from the control in both seasons. The results of this study are in harmony with those reported by Jindal and Sharma (1986) on plum; Biasl *et al*. (1991), Lowes and Woolley (1992) on Kiwi, Kabeel (1999) on persimmon and Guirguis *et al*. (2003) on pear trees.

Fruit shape index

As shown in Table 3, it is appeared that spraying with CPPU, GA_3, Milagrow and Pepton at full bloom or at fruit set had no significant effect on fruit shape index (fruit length/fruit diameter) compared with the control in both seasons.

Fruit weight

Data in Table 4 revealed that spraying with CPPU, GA_3, Milagrow and Pepton at full bloom or at fruit set had significant effect on fruit weight in the both seasons. The maximum values were recorded on trees sprayed with 10 ppm CPPU at fruit set (209.60 and 232.61g) followed in a descending order by spraying with 15 ppm CPPU at fruit set, while, the minimum values were obtained from control (171.13 and 168.7g) respectively, in both seasons.

Fruit size

As shown in Table 4, it is appeared that spraying with CPPU, GA_3, Milagrow and Pepton at full bloom or at fruit set had positive effect on fruit size in both seasons of study. It was found that spraying with 10 ppm CPPU at fruit set (171.75 and 194.37cm^3) recorded the highest values of fruit size followed in a descending order by spraying with 15 ppm CPPU at fruit set, whereas, the lowest values were obtained from control (129.54 and 126.72cm^3) respectively, in both seasons. However, the above results were in line with those obtained by El-Barkooky (1985) and Greene (1989) on apple; Jindal and Sharma (1986) on plum; Kabeel (1999) on persimmon and Guirguis *et al*. (2003) on pear trees.

TABLE 2. Effect of different treatments on yield/tree (kg) and the monetary value of yield (L.E.).

Treatments	Yield/tree (kg)		The monetary value of yield (L.E.)	
	2011 season	2012 season	2011 season	2012 season
Milagrow at 50 ppm at full bloom	47.55	38.56	134.10	96.73
GA_3 at 20 ppm at full bloom	61.42	43.46	125.65	122.48
CPPU at 5 ppm at full bloom	71.11	53.65	117.95	104.93
CPPU at 10 ppm at full bloom	72.27	76.98	136.65	199.05
CPPU at 15 ppm at full bloom	72.15	75.75	129.53	167.95
Peptone at 2000 ppm at full bloom	62.14	41.00	131.25	98.58
Milagrow at 50 ppm at fruit set	56.80	48.53	154.00	121.55
GA_3 at 20 ppm at fruit set	73.27	71.61	163.08	162.70
CPPU at 5 ppm at fruit set	77.46	83.80	153.38	199.73
CPPU at 10 ppm at fruit set	104.10	99.25	192.38	222.98
CPPU at 15 ppm at fruit set	86.86	94.96	176.18	202.88
Peptone at 2000 ppm at fruit set	69.77	39.19	147.53	136.83
Control (without treatment)	42.44	33.18	125.13	60.08
LSD at (0.05)	9.81	14.64	49.06	52.96

TABLE 3. Effect of different treatments on fruit firmness (lb/inch$_2$) and fruit shape index.

Treatments	Fruit firmness (lb/inch^2)		Fruit shape index	
	2011 season	2012 season	2011 season	2012 season
Milagrow at 50 ppm at full bloom	13.24	14.26	1.23	1.22
GA_3 at 20 ppm at full bloom	11.34	12.05	1.28	1.25
CPPU at 5 ppm at full bloom	14.60	11.73	1.31	1.21
CPPU at 10 ppmat full bloom	12.58	11.64	1.32	1.26
CPPU at 15 ppm at full bloom	13.28	12.30	1.17	1.32
Peptone at 2000 ppm at full bloom	13.53	12.50	1.29	1.17
Milagrow at 50 ppm at fruit set	15.45	12.70	1.24	1.25
GA_3 at 20 ppm at fruit set	12.56	13.88	1.23	1.30
CPPU at 5 ppm at fruit set	14.18	13.11	1.27	1.19
CPPU at 10 ppm at fruit set	13.34	11.78	1.27	1.18
CPPU at 15 ppm at fruit set	14.41	11.32	1.31	1.29
Peptone at 2000 ppm at fruit set	13.91	12.78	1.29	1.20
Control (without treatment)	19.38	20.95	1.28	1.19
LSD at (0.05)	4.54	4.78	N.S.	N.S.

TABLE 4. Effect of different treatments on fruit weight (g) and fruit size (cm^3).

Treatments	Fruit weight (g)		Fruit size (cm^3)	
	2011 season	**2012 season**	**2011 season**	**2012 season**
Milagrow at 50 ppm at full bloom	191.22	193.12	153.75	151.88
GA_3 at 20 ppm at full bloom	186.68	178.35	146.25	138.25
CPPU at 5 ppm at full bloom	174.30	174.38	131.67	138.27
CPPU at 10 ppmat full bloom	179.78	198.40	132.50	147.63
CPPU at 15 ppm at full bloom	175.40	203.64	137.50	153.19
Peptone at 2000 ppm at full bloom	190.03	180.87	151.49	143.64
Milagrow at 50 ppm at fruit set	193.40	186.88	157.13	148.37
GA^3 at 20 ppm at fruit set	203.53	209.38	163.75	171.25
CPPU at 5 ppm at fruit set	187.09	207.24	146.25	173.75
CPPU at 10 ppm at fruit set	209.60	232.61	171.75	194.37
CPPU at 15 ppm at fruit set	207.13	229.92	168.42	187.64
Peptone at 2000 ppm at fruit set	198.20	191.47	159.37	154.19
Control (without treatment)	171.13	168.70	129.54	126.72
LSD at (0.05)	9.85	6.67	8.74	6.53

Fruit TSS

Data in Table 5 revealed that spraying with CPPU, GA_3, Milagrow and Pepton at full bloom or at fruit set had better effect on fruit TSS in the both seasons. The maximum values were recorded on trees sprayed with 10 ppm CPPU at fruit set (15.33 and 15.67%) followed in a descending order by spraying with 15 ppm CPPU at fruit set, while, the minimum values were obtained from control (12.23 and 12.10%) and spraying with Milagrow at full bloom in both seasons, respectively.

Fruit acidity

As shown in Table 5, it is appeared that spraying with CPPU, GA_3, Milagrow and Pepton at full bloom or at fruit set had significant effect on fruit acidity in both seasons. It was found that spraying with 10 ppm CPPU at fruit set recorded the lowest values of fruit acidity (0.72 and 0.65%) followed in an ascending order by spraying with 15 ppm CPPU at fruit set, whereas, the highest values were obtained from control (0.87 and 0.83%) and spraying with Milagrow at full bloom in the both seasons, respectively. The above results are in agreement with those obtained by Jindal and Sharma (1986) on plum; Biasl *et al*. (1991), Lowes and Woolley (1992) on Kiwi; Kabeel (1999) on persimmon and Guirguis *et al*. (2003) on pear trees.

Conclusions

The present results clearly showed a positive effect to CPPU (sitofex) on fruit set and retained fruit percentages, number of fruits/tree, fruit yield, monetary value of yield and fruit quality components. Hence, we can increase the pear fruit yield by about 59.26-66.54% as well as the yield monetary value to about 34.96-73.06% than the control. In this respect, Guirguis *et al*. (2003 and 2010) and Nie Lei *et al*. (2006) stated that CPPU (20 ppm) increased pear, kaki and pomelo fruit set. Also, Cai Lihong (1996) and Guirguis *et al*. (2010) found that spraying grape and kaki trees with 5-20mg/L CPPU significantly increased yield per tree by 20-48% and the fruit quality was improved as well. These results may be described by the positive action of CPPU where sitofex may enhance both cell division and cell enlargement, and has a great role in activating the biosynthesis of proteins, RNA and DNA as well as reduce pre-harvest fruit drop (Nickell, 1986).

So, we can recommend pear growers to spray their orchards with 10 ppm CPPU at fruit set to improve yield, fruit quality and monetary value and to gain the effectiveness of sitofex which can open the door widely as a new opportunity for managing pear fruit production.

TABLE 5. Effect of different treatments on fruit TSS (%) and fruit acidity (%) .

Treatments	Fruit TSS (%)		Fruit acidity (%)	
	2011 season	2012 season	2011 season	2012 season
Milagrow at 50 ppm at full bloom	12.47	13.07	0.85	0.80
GA_3 at 20 ppm at full bloom	14.50	14.43	0.83	0.79
CPPU at 5 ppm at full bloom	14.87	15.20	0.80	0.75
CPPU at 10 ppm at full bloom	14.47	15.33	0.81	0.78
CPPU at 15 ppm at full bloom	12.90	14.87	0.79	0.74
Peptone at 2000 ppm at full bloom	12.97	13.16	0.81	0.78
Milagrow at 50 ppm at fruit set	13.27	13.24	0.80	0.75
GA_3 at 20 ppm at fruit set	14.43	14.20	0.83	0.79
CPPU at 5 ppm at fruit set	14.81	15.13	0.79	0.74
CPPU at 10 ppm at fruit set	15.33	15.67	0.72	0.65
CPPU at 15 ppm at fruit set	15.27	15.53	0.76	0.68
Peptone at 2000 ppm at fruit set	14.40	14.70	0.79	0.76
Control (without treatment)	12.23	12.10	0.87	0.83
LSD at (0.05)	1.48	2.00	0.02	0.01

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تأثير السيتوفكس ، الجبريلين، الميلاجروا، الببتون على الإنتاج وجودة الثمار في أشجار الكمثرى صنف الليكونت

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أجريت هذه الدراسة خلال موسمي (٢٠١١، ٢٠١٢) على أشجار الكمثرى صنف "الليكونت"، حيث كان عمر الأشجار سبع سنوات ومطعمة على أصل "بيرس كومينس" مزروعة فى تربة جيرية وكانت تروى بنظام الرى بالغمر فى مزرعة خاصة بمنطقة برج العرب التابعة لمحافظة الاسكندرية. تم اختيار ٣٩ شجرة متماثلة ومزروعة على مسافة ٥ × ٥ متر وأجريت التجربة متضمنة ثلاثة عشرة معاملة وهى كالاتى: ، الرش بالسيتوفكس، الجبريلين، الميلاجروا، الببتون عند التزهير الكامل أو عند العقد بالاضافة إلى أشجار الكنترول.

أظهرت النتائج إلى أن رش السيتوفكس بتركيز ١٠ أو ١٥ جزء في المليون بعد العقد سجلت أعلى القيم بالنسبة للمحصول والعائد النقدى للمحصول ونسبة العقد ووزن وحجم ونسبة المواد الصلبة الذائبة الكلية فى الثمار وأقل القيم بالنسبة إلى صلابة وحموضة الثمار، بينما أشجار الكنترول والرش بالميلاجروا عند التزهير الكامل سجلت أقل القيم بالنسبة للمحصول ونسبة العقد ووزن وحجم ونسبة المواد الصلبة الذائبة الكلية فى الثمار وأعلى القيم بالنسبة إلى صلابة وحموضة الثمار.