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RESPONSE OF 'LE-CONTE' PEAR (*Pyrus communis* L.) TREES TO FOLIAR APPLICATION WITH SOME BIOSTIMULANTS

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ABSTRACT: *This study was conducted in a private farm, in Menofia Governorate during the 2004 and 2005 seasons on 'Le-Conte' pear (Pyrus communis L.) trees to evaluate foliar treatments with any of the commercial biostimulants Promise, Discovery and Folgers and the experimental biostimulant preparation Mixture singly or in combination with foliar treatment with bread yeast (Saccharomyces cerevisiae) on plant growth characters, yield and its components, and fruit quality attributes. A split-plot system in a randomized complete block design was used. The four biostimulants showed significant positive effects on all measured characters, while the yeast treatment had no positive effects except on leaf N and P analysis rather, it caused significant negative effects on leaf K analysis and fruit weight and size. Treatment with Folgers alone showed the strongest positive effect on foliage characters; leaf chlorophyll content and N analysis; percentage of fruit set and retained fruits; number of fruits per tree; and fruit weight, volume, dimensions, and percentages T S S and acidity this treatment was followed without significant differences in most of the studied characters, by Mixture treatment. Promise was the least effective biostimulant, as it did not differ significantly from the control in most of the measured characters. It was recommended for improvement of growth, yield and fruit quality attributes of 'Le-Conte' pear to treat trees with 3 foliar applications of Folgers, each at the rate of 1.2 ml in 6.6 liters of water/tree, followed as a second choice by Mixture treatment at the rate of 15.3 ml in 6.6 liters of water/tree.*

Key words: *Pear, pyrus communis, blostimulants, yeast, growth stimulants, leaf N P k analysis, fruit quality, fruit set, retained fruits.*

INTRODUCTION

Improving yield and fruit quality without adversely affecting the environment is a major goal of horticulturists and could be achieved by using the biostimulants in crop production. Biostimulants may contain microorganisms or natural products as cytokinin, amino acids and organic acids (Russo and Berlyn, 1990).

Foliar application of commercial or experimental biostimulants have been tried with variable success. For instance, spraying of SA-100/G3 or Siapton, preparations containing amino acids and peptides, enhanced fruit set in 5

cultivars of apple, pear and plum (Filiti *et al.*, 1986). Also, application of Goemar biostimulants, derived from marine algae, increased fruit set, size and final weight of apples, pears, nectarines, apricot, plums and cherries (Kloareg *et al.*, 1996). Meanwhile, 6-9 foliar applications/year of 0.01 % Algan (produced from brown algae and contains microelements, amino acids and plant growth regulators) or 0.2 % Wuxal (NPK fertilizer + microelements) to 'Jonagold' apple trees had no effect on flowering and crop load, but Algan tended to increase sugar : acid ratio and enhanced fruit color (Bertschinger *et al.*, 1997).

Improvement of yield, growth and/or fruit quality attributes have been also obtained with follar sprays of active bread yeast (*Saccharomyces cerevisiae*) on 'Anna' apple (Ahmed *et al.*, 1995 and Mansour, 1998). 'Red Roumy' grapevines (Ahmed *et al.*, 1997), 'Valencia' orange (Hegab *et al.*, 1997), banana plants (El-Shamma, 2001) and 'Canino' apricot (Eissa *et al.*, 2003); with soil and foliar application to 'Thomson Seedless' grapevines (El-Mogy *et al.*, 1998); and with soil application to 'Canino' apricot (Eissa, 2003).

Micronutrients are usually included in most commercial biostimulant preparations, but they have been also used singly or in various combinations. Spraying pear trees with a complete fertilizer improved plant growth, flowering, yield and fruit quality (Kabeel *et al.*, 1998). Foliar application of boron to 'Conference' pear trees before full bloom increased fruit set and fruit yield, but had no effect on leaf N, P, K or Mg content (Wojcik & Wojcik, 2003). According to Piaggesi *et al.* (2002), foliar application of chelated microelement-based products to 'Abate Fetel' pear plants increased the element content in leaves.

The objectives of this investigation were, therefore, to study the response of pear trees to foliar application of active bread yeast, some commercial biostimulants and an experimental one with respect to foliage characters, leaf NPK content, yield and yield components and fruit quality attributes.

MATERIALS AND METHODS

This study was conducted on 12 years old Le – Conte pear trees grafted on *P. communis* and grown 5 × 5 m apart in a loamy clay soil in a private farm in Menofia Governorate, Egypt during the 2004 and 2005 seasons. The same trees were used in both seasons the objective was to improve fruit yield and quality of 'Le-Conte' pear through foliar application of certain biostimulants. Treatments were 3 foliar applications with either Promise, Discovery and Folgers (registered commercial products), Mixture (an experimental preparation) or water, either alone or in combination with dry bread yeast. The 3 commercial stimulants are produced by Agrico International, Giza, Egypt. Promise contains 5% N, 30% K_2 O, 1.5% Ca, 20 S, 1% Fe- EDTA, and 0.1% of each of Mn., Mg., and Cu. EDTA. Discovery contoins 9% N; 3% Ca- EDTA; 0.2%Mg – EDTA; 1.5% B; 10% S; 0.2% of each of Zn., Fe., and Mn- EDTA; amino acids; organic acids; vitamins C, B,

thiamine, and nictinamide; and nucleic acids. Folgers, contains unidentified natural growth stimulants. The experimental preparation, Mixture, on the other hand, contains nutrient elements, polypeptides, amino acids and some enzymes. Active bread yeast was obtained from local markets. Foliar application of the various biostimulants was carried out in full bloom on April 4, May 25(after fruit set), and June 20, 2004 and on April 9, May 30 and June 30, 2005. In each spray application every 3 trees received 14 g of either Promise or Discovery, 3.5 ml of Folgers, 46 ml of Mixture or 50 g of dry yeast in 20 liters of water.

A split-plot system in a randomized complete block design was used. Promise, Discovery, Folgers, Mixture and water (control) treatments were allocated to the main plots, while treatment with yeast, or without were randomized in the sub-plots. Three replicates were used and each experimental unit consisted of one tree.Trees selected for the study were nearly homogenous in growth. Tree measurements were made on 5 nearly similar 2-years-old branches around each tree in both seasons. Data were recorded on: (a) number of leaves/branch during July, (b) leaf area during August using a CL203 Area Meter (CID, Inc., USA) based on measurements recorded on 10 leaves, (c) leaf chlorophyll during Aug. using a SPAD 502 chlorophyll meter (Minolta Corporation, Ramsey, NJ, USA) based on readings recorded on 10 leaves as above, (d) percentage fruit set (in 2005 season only), (e) percentage of retained fruits in July to total fruit set in May (f) number of fruits per branch, and (g) number of fruits per tree.

Fruit measurements were conducted on 5 harvested fruits/ experimental unit and included fruit weight, size, firmness using a pressure tester with a $_{1/4}$ inch plunger (catalytic Generators, Inc., Norfolk, VA, USA), polar and equatorial dimensions, polar/equatorial diameter ratio, total soluble solids (TSS) content using a hand refractometer, titratable acidity (TA) as percent malic acid (AOAC, 1975) and TSS/TA ratio.

Leaf nutrient analysis included N by the Kjeldahl digestion method as described by Jackson (1973), P using the ammonium molybdate method as described by Trough and Mayer (1949), and K using wet digestion (Piper, 1950) and the flame photometer method according to Brown and Lilleland (1946). Leaf samples were collected for chemical analysis in late Aug. of both seasons. Each sample consisted of 30 leaves/tree taken from the middle of branches. Leaves were washed several times with tap water, rinsed with distilled water, and then dried at 70 °C to a constant weight. Dried leaves were ground in a stainless steel rotary knife mill, screened through 20 mesh screen, and 0.5 g dried samples were taken for analysis.

Data obtained were statistically analyzed, and mean separation was according to Duncan's multiple range test (Steel and Torrie, 1960)

RESULTS

Foliage characters and leaf chlorophyll and NPK analysis

Treatments applied significantly affected the measured foliage characters, viz., number of leaves/branch, leaf area and leaf chlorophyll content measured as SPAD readings (Table 1). These significant effects were due mainly to the application of biostimulants Promise, Discovery, Folgers and Mixture. The only significant effect for yeast application, which was negative, was on the number of leaves/branch in the first season. Folgers was, by far, the best in all 3 measured characters in both seasons, though it was not significantly different from the other biostimulants used with regard to leaf area in 2005 and leaf chlorophyll content in both seasons. Folgers gave significantly higher number of leaves/branch than Promise and Mixture in 2004 and all three other biostimulants in 2005, while it gave significantly higher leaf area than Promise in 2004. Interaction effects were significant in all characters measured, and the best treatment combinations were Folgers alone, Mixture, and Discovery + yeast in all characters. However, some other treatments were not statistically different from the above top treatments, viz., (a) Folgers + yeast on number of leaves/branch in 2005 and leaf area in 2004, (b) all other treatments with commercial and experimental biostimulants on leaf area in 2005 and (c) all other such applications except Promise + yeast and Mixture + yeast on leaf chlorophyll content in 2004.

Likewise, treatments applied had significant effects on leaf NPK analysis (Table 2). In both seasons, leaf N and P analysis was significantly higher and K analysis was significantly lower with yeast application than without its application. Meanwhile, biostimulants effect on leaf NPK analysis was not consistent in both years. The highest significant N analysis was obtained with the Mixture treatment in 2004 and with Folgers in 2005; the highest P analysis was obtained with Discovery in 2004 and with Promise and Folgers in 2005; while the top K analysis was attained with Discovery in 2004 and Mixture in 2005. Interaction effects were consistent also, but the highest and/or second highest significant effects in both years were obtained with both Folgers alone and water + yeast treatments for N analysis, both Promise alone and Folgers + yeast treatment for P analysis, and mixture alone and promise + yeast for K analysis.

Table (1): Effect of different stimulants on foliage characters and chlorophyll content of 'Le-Conte' pear trees *.

Treatment	No. of leaves/branch		Leaf area (cm^2)		Chlorophyll	
	2004	2005	2004	2005	2004	2005
Promise + yeast	66.3 c	69.2 d	22.8 cd	39.5 ab	49.1 bcd	50.2 bc
Promise	71.6 c	81.3 bc	23.7 cd	41.8 ab	51.4 abcd	51.8 bc
Discovery +	88.0 ab	87.1 ab	28.0 abc	44.1 a	53.2 ab	52.9 abc
Discovery	68.8 c	74.3 cd	22.9 cd	40.5 ab	50.3 abcd	51.1 bc
Folgers + yeast	74.1 bc	85.4 abc	24.8 bcd	42.4 ab	52.0 abc	51.1 bc
Folgers	97.5 a	95.0 a	31.6 a	47.1 a	56.3 a	58.6 a
Mixture + yeast	68.9 c	73.1 cd	24.2 cd	40.2 ab	49.9 bcd	50.8 bc
Mixture	91.0 a	91.3 ab	30.5 ab	45.0 a	56.1 a	56.1 ab
Water + yeast	47.0 d	50.5 e	21.0 d	34.6 b	45.3 d	49.0 c
Water (Control)	49.4 d	56.5 e	22.3 cd	36.0 b	46.0 cd	49.8 bc
Mean of main treatments						
Promise	69.0 b	75.3 b	23.3 b	40.7 a	50.3 a	51.0 ab
Discovery	78.4 ab	80.7 b	25.4 ab	42.3 a	51.8 a	52.0 ab
Folgers	85.8 a	90.2 a	28.2 a	44.8 a	54.2 a	54.9 a
Mixture	68.9 b	82.2 b	27.4 ab	42.6 a	53.0 a	53.5 ab
Water (control)	48.2 c	53.5 c	21.7 c	35.3 b	45.7 b	49.4 b
Mean of sub-treatments						
Yeast	68.9 a	73.1 b	24.2 a	40.2 a	49.9 a	50.8 a
Without yeast	75.7 a	79.7 a	26.2 a	42.1 a	52.0 a	53.5 a

*Within each group of comparable treatments in individual columns, values followed by a letter in common are not significantly different from each other at 0.05 level according to Duncan's multiple range test.

Table (2): Effect of different stimulants on leaf NPK analysis (%) of 'Le-Conte' pear trees *.

Treatment	N		P		K	
	2004	2005	2004	2005	2004	2005
Promise + yeast	1.83 i	2.73 d	0.31 d	0.33 e	1.55 b	1.37 b
Promise	1.88 h	2.59 e	0.58 a	0.51 b	1.60 i	1.24 e
Discovery +	2.95 c	2.54 f	0.39 c	0.41 d	1.68 a	1.23 e
Discovery	2.43 f	2.82 c	0.60 a	0.35 e	1.22 f	1.31 c
Folgers + yeast	2.43 f	2.55 f	0.54 b	0.64 a	1.08 h	1.16 f
Folgers	3.00 b	3.24 a	0.14 f	0.19 f	0.97 i	0.99 h
Mixture + yeast	2.62 e	2.45 g	0.39 c	0.47 c	1.42 d	1.30 cd
Mixture	2.22 g	2.03 i	0.15 f	0.17 fg	1.46 c	1.46 a
Water + yeast	3.25 a	2.96 b	0.31 d	0.48 c	1.38 e	1.28 d
Water (Control)	2.76 d	2.22 h	0.20 e	0.16 e	1.17 g	1.13 g
Mean of main treatments						
Promise	1.86 d	2.66 c	0.46 b	0.42 a	1.31 c	1.31 b
Discovery	2.69 c	2.68 b	0.50 a	0.38 b	1.45 a	1.27 c
Folgers	2.72 b	2.90 a	0.34 c	0.42 a	1.03 d	1.08 e
Mixture	2.74 a	2.50 d	0.23 e	0.33 c	1.42 b	1.37 a
Water (control)	2.69 c	2.34 e	0.30 d	0.32 c	1.30 c	1.22 d
Mean of sub-treatments						
Yeast	2.64 a	2.81 a	0.40 a	0.40 a	1.21 b	1.22 b
Without yeast	2.34 b	2.41 b	0.32 b	0.34 b	1.39 a	1.27 a

*Within each group of comparable treatments in individual columns, values followed by a letter in common are not significantly different from each other at 0.05 level according to Duncan's multiple range test.

Yield components

With the exception of yeast application, which had a negative significant effect on the number of fruits/tree in 2005, all other biostimulants used had significant positive effects on all measured yield components, viz., percentage of fruit set, percentage of retained fruits, number of fruits/branch, and number of fruits/tree (Table 3). Once again, Folgers application gave the best results in all characters in both seasons, though it was not statistically different from (a) treatment with other biostimulants with regard to the number of fruits/branch in both seasons, (b) Mixture with regard to the percentage of retained fruits in both seasons, and (c) Discovery and Mixture with regard to fruit set percentage in 2005. Interaction effects were also significant in all characters. Treatment with Folgers alone was significantly the best in both seasons, but was mostly not significantly different from treatment with Mixture alone which came next. However, biostimulants used were not significantly different from each other with regard to the number of fruits/branch. Treatment with promise + yeast was not effective in improving any character, relative to the control, except number of fruits per tree in both seasons.

Table (3): Effect of different stimulants on yield components of 'Le-Conte' pear trees*

Treatment	Fruit set (%)	Retained fruits (%)		No. of		No. of fruits/tree	
	2005	2004	2005	2004	2005	2004	2005
Promise +	4.69 cd	71.0 def	73.0	6.3 bc	6.7 abc	686.0 b	600.0 f
Promise	5.90 bcd	78.0 cd	76.7 cd	8.4 a	8.7 a	700.0 b	646.7 e
Discovery +	8.13 abc	88.9 abc	86.1 bc	7.6 ab	7.6 a	728.3 b	700.0 c
Discovery	5.37 cd	74.1 de	75.0 cd	6.8 ab	7.0 ab	700.0 b	621.7 f
Folgers +	6.11 bcd	82.0 bcd	81.8 c	7.0 ab	7.5 a	726.7 b	676.0 d
Folgers	9.88 a	100.0 a	100.0 a	8.2 ab	8.3 a	800.0 a	786.7 a
Mixture +	6.31 bc	75.4 bcd	75.4 cd	6.4 ab	6.6 abc	713.3 b	622.5 f
Mixture	9.02 ab	92.5 ab	96.0 ab	8.0 ab	7.9 a	786.6 a	726.3 b
Water +	2.82 de	59.5 f	60.5 e	4.8 c	4.6 c	513.3 d	513.3 h
Water	3.50 d	61.6 ef	64.3 de	4.9 c	5.1 bc	566.7 c	566.7 g
Promise	5.30 bc	74.5 b	74.8 bc	7.4 a	7.7 a	693.0 b	623.4 c
Discovery	6.75 ab	81.5 b	80.6 bc	7.2 a	7.3 a	714.2 b	660.9 b
Folgers	8.00 a	91.0 a	90.9 a	7.6 a	7.9 a	763.4 a	731.7 a
Mixture	7.67 a	84.0 ab	85.7 ab	7.2 a	7.3 a	750.0 a	674.4 b
Water	3.16 c	60.6 c	62.4 d	4.8 b	4.8 b	540.0 c	540.0 d
Yeast	5.61 a	75.4 a	75.4 a	6.4 a	6.6 a	673.5 a	622.5 b
Without	6.73 a	81.2 a	82.4 a	7.3 a	7.4 a	710.7 a	669.6 a

*Within each group of comparable treatments in individual columns, values followed by a letter in common are not significantly different from each other at 0.05 level according to Duncan's multiple range test.

Fruit characteristics

Unless otherwise indicated in parenthesis, yeast application had significant negative effects in both seasons on fruit weight, size, firmness (in 2004 only), TSS content (in 2004 only), and TSS/TA ratio, and had no significant effect on fruit dimensions, TSS (in 2005 only) and TA (Tables 4-6). Meanwhile, the other biostimulants used showed significant positive effects on all measured fruit characters in both seasons. By far, Folgers was significantly the best, giving the highest values of fruit weight, size, firmness, and TSS and the least significant value of fruit TA. However, this treatment was not statistically different from some others, especially treatment with (a) Mixture with regard to fruit polar diameter, TSS content, and TA and (b) treatment with other biostimulants with regard to fruit equatorial diameter and polar/equatorial diameter ratio (Tables 4-6). Interaction effects were significant in all measured fruit characters in both seasons, except polar/equatorial diameter ratio of fruits. Treatment with Folgers alone was the best in all other measured fruit characters, followed without significant differences, by treatment with Mixture alone in characters fruit firmness, polar diameter, TSS and TA in both seasons.

DISCUSSION AND CONCLUSION

Three foliar applications with various commercial (viz., Promise, Discovery and Folgers) and experimental (viz., Mixture) biostimulants singly or in combination with dry yeast to 'Le-Conte' pear trees caused varied significant effects on all measurements recorded, i.e., foliage characters (Table 1), leaf NPK analysis (Table 2), yield components (Table 3), and fruit quality attributes (Tables 4-6).

Table (4): Effect of different stimulants on fruit weight, size and firmness of 'Le-Conte' pear trees *.

Treatment	Fruit weight (g)		Fruit size (cm^3)		Fruit firmness ($lb/inch^2$)	
	2004	2005	2004	2005	2004	2005
Promise + yeast	160.1 f	183.0 fg	146.3 f	163.7 f	8.1 ce	8.9 cd
Promise	174.1 e	193.7 e	161.0 e	174.3 de	9.2 de	10.4 c
Discovery + yeast	211.7 c	221.0 c	183.2 c	202.4 c	10.9 bc	16.6 ab
Discovery	165.3 f	188.1 ef	151.5 f	170.1 ef	8.6 de	9.4 cd
Folgers + yeast	183.9 d	202.0 d	170.6 d	179.1 d	9.8 cd	15.3 b
Folgers	247.1 a	249.4 a	227.9 a	229.1 a	12.6 a	17.6 a
Mixture + yeast	169.6 ef	195.9 df	149.2 f	169.3 ef	8.7 de	11.9 c
Mixture	232.0 b	236.1 b	215.3 b	213.9 b	11.8 ab	17.1 ab
Water + yeast	122.8 h	177.6 g	96.5 h	132.0 g	5.9 f	6.8 e
Water (Control)	137.8 g	178.1 g	112.0 g	138.1 g	6.3 f	7.9 de
Mean of main treatments						
Promise	167.1 d	188.4 d	153.6 d	169.0 c	8.7 c	9.7 d
Discovery	188.5 g	204.6 c	167.4 c	186.3 b	9.8 b	13.0 c
Folgers	215.5 a	225.7 a	199.3 a	204.1 a	11.2 a	16.5 a
Mixture	200.8 b	216.0 b	182.2 b	191.6 b	10.3 b	14.5 b
Water (control)	130.3 e	177.9 e	104.3 e	135.1 d	6.1 d	7.4 e
Mean of sub-treatments						
Yeast	169.6 b	195.9 b	149.2 b	169.3 b	8.7 b	11.9 a
Without yeast	191.3 a	209.1 a	173.5 a	185.1 a	9.7 a	12.5 a

*Within each group of comparable treatments in individual columns, values followed by a letter in common are not significantly different from each other at 0.05 level according to Duncan's *multiple range* test.

Table (5): Effect of different stimulants on fruit dimensions of 'Le-Conte' pear trees *.

Treatment	Polar diameter (cm)		Equatorial diameter		Polar	
	2004	2005	2004	2005	2004	2005
Promise + yeast	8.2 cd	8.6 cd	6.3 bcd	6.6 ab	1.3 a	1.3 a
Promise	8.5 bcd	8.7 cd	6.5 abcd	6.8 ab	1.3 a	1.3 a
Discovery +	8.9 b	9.4 ab	6.8 ab	7.0 a	1.3 a	1.4 a
Discovery	8.4 bcd	8.6 cd	6.4 bcd	6.7 ab	1.3 a	1.3 a
Folgers + yeast	8.7 bc	9.0 bc	6.7 abc	6.9 a	1.3 a	1.3 a
Folgers	9.9 a	9.8 a	7.3 a	7.2 a	1.4 a	1.4 a
Mixture + yeast	8.4 bcd	8.8 c	6.4 bcd	6.7 ab	1.3 a	1.3 a
Mixture	9.9 a	9.4 ab	7.1 ab	7.1 a	1.4 a	1.4 a
Water + yeast	7.9 d	8.2 d	5.8 d	6.1 b	1.4 a	1.4 a
Water (Control)	7.9 d	8.3 d	5.9 cd	6.1 b	1.4 a	1.4 a
Mean of main treatments						
Promise	8.4 cd	8.7 cd	6.4 b	6.7 a	1.3 a	1.3 a
Discovery	8.7 b	9.0 b	6.6 ab	6.9 a	1.3 a	1.3 a
Folgers	9.3 a	9.4 a	7.0 a	7.0 a	1.4 a	1.4 a
Mixture	9.2 a	9.1 ab	6.8 ab	6.9 a	1.4 a	1.4 a
Water (control)	7.9 c	8.3 d	5.9 c	6.1 b	1.4 a	1.4 a
Mean of sub-treatments						
Yeast	8.4 b	8.8 a	6.4 a	6.7 a	1.3 a	1.3 a
Without yeast	8.9 a	8.9 a	6.6 a	6.8 a	1.4 a	1.4 a

*Within each group of comparable treatments in individual columns, values followed by a letter in common are not significantly different from each other at 0.05 level according to Duncan's multiple range test.

Table (6): Effect of different stimulants on fruit chemical characters of 'Le-Conte' pear trees *.

Treatment	TSS (%)		Titratable acidity (%)	
	2004	2005	2004	2005
Promise + yeast	11.33 cd	11.83 c	0.55 ab	0.60 abc
Promise	12.00 bcd	12.67 bc	0.49 bc	0.57 abcd
Discovery + yeast	12.83 ab	13.33 ab	0.42 cd	0.51 cde
Discovery	11.67 bcd	12.00 c	0.51 bc	0.58 abcd
Folgers + yeast	12.50 abc	13.00 ab	0.49 bc	0.54 bcd
Folgers	13.33 a	13.83 a	0.27 e	0.42 e
Mixture + yeast	11.83 bcd	12.00 c	0.52 abc	0.58 abcd
Mixture	12.83 ab	13.67 a	0.33 de	0.49 de
Water + yeast	10.67 d	9.83 d	0.60 a	0.68 a
Water (Control)	10.83 d	10.17 d	0.58 ab	0.64 ab
Mean of main treatments				
Promise	11.67 b	12.25 b	0.52 ab	0.59 b
Discovery	12.25 ab	12.67 b	0.47 b	0.55 bc
Folgers	12.92 a	13.42 a	0.38 c	0.48 c
Mixture	12.33 ab	12.84 ab	0.43 bc	0.54 bc
Water (control)	10.75 c	10.00 c	0.59 a	0.66 a
Mean of sub-treatments				
Yeast	11.83 b	12.00 a	0.52 a	0.58 a
Without yeast	12.13 a	12.47 a	0.44 b	0.54 a

*Within each group of comparable treatments in individual columns, values followed by a letter in common are not significantly different from each other at 0.05 level according to Duncan's multiple range test.

With a few exceptions, especially concerning leaf NPK content, the relative plant response to biostimulants application was mostly consistent in all measured characters and in both years of the study. Folgers application was, by far, the best in improving most measured characters, followed mostly with Mixture treatment without significant differences between the two treatments in most characters. Treatment with Discovery followed in order without significant differences from Folgers treatment in only some characters. Meanwhile, foliar treatment with Promise was the least effective as it was not statistically different from the control treatment in most measured characters. This constancy in the relative treatment effects on various measured characters reflects: (a) the positive association and interdependence among the measured characters (i.e., foliage characters, yield and yield components, and fruit quality attributes) and (b) the variable combinations of the various organic and inorganic components affecting plant growth and development in the used commercial and experimental biostimulants. Our results are in harmony with previous findings concerning the varied positive effects of the foliar application of biostimulants (Filiti *et al.*, 1986; Kloareg *et al.*, 1996; Bertschinger *et al.*, 1997) and macro and micronutrients (Kabeel *et al.*, 1998; Piaggesi *et al.*, 2002; Wojcik and Wojcik, 2003), which are usually included in most biostimulants preparations, on various attributes of deciduous fruit trees growth and development. The mechanism of their stimulative effects vary according to the used biostimulant. For instance, Kloareg *et al.* (1996) suggested that algal creams of Goemar biostimulants contain oligosaccharides with 'signal' activity and have elicitor effects on cell activity and regulation of endogenous polyamine synthesis. Meanwhile, Filiti *et al.* (1986) attributed the positive effect of SA-10/G3 or Siapton, which are preparations containing amino acids and peptides, on fruit set in apples, pears and plums to enhanced pollen germination and markedly increased pollen tube growth.

In this study, the foliar application of bread yeast had no significant positive effect on any of the measured characters except leaf N and P analysis. In fact, this treatment had a significant negative effect on some characters, viz., fruit firmness and TSS content in 2004; number of leaves/branch, and number of fruits/tree in 2005; and leaf K content, and fruit weight and size, in both seasons. These results are contradictory to previous results obtained for foliar or soil application of yeast to other fruit crops, viz., apples (Ahmed *et al.*, 1995; Mansour *et al.*, 1998), apricot (Eissa, 2003 and Eissa *et al.*, 2003), oranges (Hegab *et al.*, 1997), grapevines (Ahmed *et al.*, 1997, El-Mogy *et al.*, 1998) and banana plants (El-Shammaa, 2001). It is possible that the response of pear trees to yeast application is different from that of other fruit crops tested due to specific heritable attributes of pears, but this possible explanation requires further clarification.

In conclusion, it was evident that 3 foliar applications of the biostimulant 'Folgers' each at 1.2 ml in 6.6 liters of water per tree (3.5 ml in 20 L water/3

trees), to 'Le-Conte' pears cause significant positive effect on foliage characters, yield components, and fruit quality attributes. This treatment is recommended for use in 'Le-Conte' pear orchards. The experimental preparation 'Mixture' at 15.3 ml in 6.6 liters of water per tree came next in order of improving growth, yield and fruit quality attributes and its use is also recommended as it was not significantly different from Folgers regarding their effects on most characters.

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استجابة أشجار الكمثرى الليكونت (بيرس كميونس) للرش ببعض المنشطات الحيوية

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أجريت هذه الدراسة فى مزرعة خاصة بمحافظة المنوفية خلال عامى ٢٠٠٤، ٢٠٠٥ على أشجار الكمثرى الليكونت بهدف تقييم تأثير رش النموات الخضرية للأشجار بأي من منشطات النمو الحيوية التجارية: برومس، ديسكفرى، وفولجرز والمنشط الحيوى التجريبى مكستشر منفردة، أو مع الرش بخميرة الخبز سكارواميسيس سريفيزيا على صفات النمو الخضرى والمحصول ومكوناته وصفات جودة الثمار، وذلك فى تجربة بنظام القطع المنشقة بتصميم القطع الكاملة العشوائية.

أظهرت الدراسة تأثيراً معنوياً إيجابياً للمعاملة بالمنشطات الحيوية الأربعة على جميع الصفات المدروسة، بينما لم تكن للمعاملة بالخميرة أي تأثيرات إيجابية باستثناء تأثيرها على محتوى الأوراق من النيتروجين والفوسفور, وفى الوقت الذى قللت فيه جوهرياً من محتوى الاوراق من البوتاسيوم وحجم الثمار ووزنها.

وقد أعطت المعاملة بمنشط النمو فولجرز منفرداً أقوى تأثير إيجابي على كل من صفات النمو الخضرى ومحتوى الاوراق من الكلوروفيل والنيتروجين, والنسبة المئوية لكل من عقد الثمار والثمار المتبقية, وعدد الثمار الكلى بالشجرة, ووزن الثمرة وحجمها وقطريها ونسبة محتواها من المواد الصلبة الذائبة الكلية والحموضة المعايرة. وقد تلى هذه المعاملة فى التأثير بدون فرق معنوى فى كثير من الصفات التى تمت دراستها المعاملة بمنشط النمو التجريبى مكستشر، وكان أقل منشطات النمو تأثيراً برومس الذى لم يختلف فى تأثيره جوهرياً عن معاملة الكنترول فى معظم الصفات التى تمت دراستها.

ويوصى لأجل تحسين النمو والمحصول وصفات الجودة فى صنف الكمثرى ليكونت رش الأشجار ثلاث مرات بمنشط النمو فولجرز بمعدل ١,٢ سم٣ فى ٦,٦ لتر ماء/شجرة فى كل مرة أو كاختيار ثان للرش بمنشط النمو التجريبى مكستشر بمعدل ١٥,٣ سم٣ فى ٦,٦ لتر ماء/شجرة.