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Effect of Spraying GA_3 and Cyanocobalamin (Vit. B_{12}) on Fruit Set, Yield, and Fruit Quality of Le-Conte Pear Trees

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ABSTRACT

This study carried out during 2013 and 2014 seasons to study the effect of foliar application of GA_3 (at 15 and 30 ppm) and B_{12} (at 2 and 4 mg L^{-1}), and the combinations between them. The study aims to improve fruit quality of "Le-Conte "pear trees. Materials were applied at 30% of bloom, 70% of bloom and after fruit set. Measurements included: vegetative growth, leaf area, leaf chemical content, fruit yield and quality. Mentioned components, responded positively to the studied treatments. The application at high concentration GA_3 30 ppm plus B_{12} 4 mg L^{-1} is recommended to improve productivity which increased grower income. Generally, this study achieved main target for fruit producers, high yield, quality which led to increased grower income.
Keywords: Pear (*Pyrus communis*, L.), Cyanocobalamin, GA3.

INTRODUCTION

Pear fruit is considered the third importance one among the other deciduous fruits in the worldwide and 4thamong all fruits for which statistics are available. At the last years, the cultivated area of pear is reduced in Egypt since it reached about 8362 feddans with total production about 20400 metric tons according to the statistics of the Ministry of Agriculture in 2005.

There are many of factors that determines whether high yields are achieved in pears. These include the number and quality of flowers, the efficacy of cross-pollination, the severity of natural or promptedabscission of fruitlets and the rate of cell division andmaturity, therefore, the resultant of fruit size of the persisting fruits (Webster, 2002). Many pear orchards display dynamic growth andthus, low fruit set and biennial bearing (Lafer, 2008) which also have an effect on yield.

Different technologyis used to improve fruit set and size in pear yield. Growth regulators (PGRs), are applied to increase fruit set, nevertheless the outcome is not constantly positive as of smaller fruit size and a reduction in return bloom (Vanthournout *et al*., 2008). An increase in fruit set can be detected when GAs are applied, but often this can also be somewhat lost again during June drop (Northern hemisphere) (Vanthournout *et al*., 2008).

The classification of fruit set and fruit drop has shown that the key factors affecting the final yieldnoticeable themselves during the first three weeks flowering (Silva and Herrero, 2008). This is doubtless why using PGRs during this crucial period might improve fruit set in some pear cultivars. In fruit production one way to achieve high yields of high quality fruit is to reduce tree vigour, which is especially important in more vigorous cultivars (Asin *et al*., 2005). The best way to control the vegetative vigour of a fruit tree is to induce regularity in yield, which can be reachedby Gas application, but the results of these treatments are not consistent (Vanthournout *et al*., 2008).

Cobalamin, also called vitamin B_{12}, is a water-soluble vitamin (Asensi-Fabado and Munne´-Bosch, 2010). Also it found in many cell organs (Roje, 2007). Higher plants synthesize vitamin B_{12}due to they contain cobalamin-independent methioninesynthase (*Met*) (Smith *et al*., 2007). Methioninesynthasecatalyses the final reaction of the *Met* biosynthetic pathway in two ways, the first one, is catalyzed by the enzyme cystathionineγ-synthase (CgS) to form cystathionine from the substrates cysteine and *O*-phosphohomoserine. It is important to note that *O*-phosphohomoserine is also the directsubstrate of threonine so that methionine and threonine synthesis compete for a common substrate. The reaction catalyzed by *CgS i*s followed by the conversion of cystathionine to homocysteine by the enzyme cystathionine β-lyase. In the last step, a methyl group is transferred in plants from N5-methyl-tetrahydrofolic acid to homocysteine by a vitamin-B_{12}-independent methionine synthase to yield *Met*(Zeh *et al*., 2002). In plants *Met* serves as a precursor for a many of metabolic processes, including protein synthesis, as the prime methyl contributorfor a large number of biological methylations, polyamine synthesis and ethylene synthesis. Since methionine synthase is also essentialfor both the regeneration and biosynthesis of *Met*. It is the connectionpoint for two major biochemical spheresin cellular metabolism, the *Met* biosynthetic pathand the one-carbon cycle (Zeh *et al*., 2002). Many studies of cyanocobalamin were carried out on fruits to improve fruit quality attributes such Kaki fruit (Lo'ay, 2010), and in Thompson seedless (Lo'ay, 2011), and mango (Samaan *et al*., 2011), guava (Samaan *et al*., 2012), banana (El-Baz *et al*., 2016).

This study investigation the effect of foliar application of cyanocobalamin and GA_3 at different concentration on Le-Conte pear trees to improve the fruit set and quality.

MATERIALS AND METHODS

Experimental setup

Study was conducted during 2013 and 2014 on Le-Conte pear tree more than 10 years old which planted in clay soil. Trees were grafted on *Pyrus communis* rootstocks in Baramon farm in Dakahilia Gov., Egypt. Twenty-seven trees uniform in vigor and representing the average size of tree were chosen to receive the treatments in three replicates. Trees were planted at 4X6 m in clay soil. The trees received the same horticultural procuration under flood irrigation.

Trees were received treatments

1. Control
2. GA_3 15 ppm
3. GA_3 30 ppm
4. Vit. B_{12} 2 mg L^{-1}

5. Vit. B_{12} 4 mg L^{-1}
6. GA_3 15 ppm + Vit. B_{12} 2 mg L^{-1}
7. GA_3 15 ppm + Vit. B_{12} 4 mg L^{-1}
8. GA_3 30 ppm + Vit. B_{12} 2 mg L^{-1}
9. GA_3 30 ppm + Vit. B_{12} 4 mg L^{-1}

Treatments were applied at three stages, at 30% of bloom, 70% of bloom and after fruit set stage. As to cyanocobalamin application, was applied at sunset to avoid the effect of sun light on Vit. also, it was not mix with GA_3. On late August during both seasons (2013 & 2014), 20 developing shoots per tree were devoted for determining average shoot length diameter(cm) and leaf area (cm^2) using Leaf Area meter model (1-203, CID, Inc, USA) on 10 mature leaves randomly collected from each replicate.

Chemical measurements of leaf

Leaf chemical contents were determined in mid-August of both experimental seasons. Samples of 30 leaves/tree were taken at random from the previously vegetative spurs on tagged shoots of each tree. leaf samples were washed with tap water, oven dried at 70°C to a constant weight and grounded. The ground samples were digested with sulphoric acid and hydrogen peroxide (Evenhuis & DeWaard, 1980). Total nitrogen was determined calorimetrically (Evenhuis, 1978) and the colorimetric method for total carbohydrates percentage (Dubois, J.K., P.A., & F., 1956). Leaf chlorophyll reading was recorded using Minolta chlorophyll Meter SPAD-502 (Minolta camera. Co, LTD Japan) at the field (Yadava, 1986). Average of ten readings was taken from the middle of leaves from canopy tree.

Fruiting Measurements

Yield: During 2013 & 2014 seasons at harvest time, in mid-August of each season was study the total yield was estimated as weight of harvested mature fruits (Kg) per each individual tree.

Fruit quality: at harvest time of both seasons 20 mature fruit from each only tree season twenty matured fruits from each tree under study were taken at random to determine fruit quality. In each sample, fruit weight (g) and fruit volume (cm^3); fruit dimensions (diameter & length (cm) were determined. Also, fruit firmness was estimated by Magness and Taylor pressure tester which has a standard 5/16 of inch plunger and recorded as Ib. TSS (%) were determined by a hand refractometer. Fruit juice acidity (%) was determined (as malic acid) by titration with 0.1 normal sodium hydroxide with phenolphthalein as an indicator (A.O.A.C., 2005).

Statistical analysis

Data in this study were statistically analyzed in one way randomize complete block design using Co-State Program Ver. 6.3 at L.S.D at 5% level was used for means comparison of each treatment.

RESULTS AND DISCUSSION

Vegetative growth parameters

Table 1. shows a significant effect of GA3, cyanocobalamin and the combinations between them on shoot length, diameter and leaf area of 'Le-Conte' pear trees investigation study in both seasons. The combination between GA3 at 30 ppm with B12 at 4 mg L-1 gives the highest shoot length, diameter and leaf area value compared to other treatments and control trees at harvest time. The highest value of shoot length, could be due to the physiological effect of GA3 at 30 ppm plus B12 at 4 mg L-1 together enhance the accumulation of carbohydrate in tree shoot by which increase the shoot length (E. E. El-Baz, El Eraky, Lo'ay, & El-Deeb, 2011; Yehia, S.Y. Mohamed, W.A., & S.H.M., 2009). Increasing accumulation of carbohydrate by activating cribs cycle and pentose path way by B12 so, increased shoot length (Lo'ay, 2010). Afterword continuously, increased accumulation of carbohydrate during growth increased shoot diameter (Abd-El-Messeih, Yehia, Nagwa, & Mikheal, 2010) as followed increased leaf area (Nikolaos, Z., S., & P., 2003; Ramadan & Omran, 2005).

Leaf chemical analysis

The chemical leaf analysis as carbohydrate (C%), Nitrogen (N%) and the C/N ratio were presented in table 1. A significant effect of GA3 and B12 at high concentrations gives the highest content of carbohydrate and nitrogen percentage at harvest time compared to other treatment. The increases in in both carbohydrate and nitrogen and also C/N ratio according to the activation of B12 in plant cell Met service as a precursor to protein synthesis, methylations, polyamine synthesis and ethylene synthesis. Since methionine synthase is also required for both the regeneration and the biosynthesis of Met. It is the convergence point for two major biochemical domains in cellular metabolism, the Met biosynthetic pathway and the one-carbon cycle (E. E. T. El-Baz, Lo'ay, Ibrahium, & El-Deeb, 2016; Lo'ay, 2005; Zeh, Leggewie, Hoefgen, & Hesse, 2002). However, concerning to the effect of the GA3 and B12 on chlorophyll content, data in table 1. Showed the higher content with the combination of GA3 and B12 at high concentrations compared with other treatments. The data were agreement with (Sherif, El-Bary, & Mokhtar, 2013).

Fruiting measurements

Data in table 2. Presents a significant effect of GA3 and B12 on fruit measurements characteristics at harvest time. The tree yield was affected by all concentrations of GA3 and B12. The highest yield was observed with higher concentration of GA3 and B12 compared to other treatments. The increases yield values according to increasing fruit weight and volume. These effects are related to GA3 treatment that the plant system are responsible for dividing tissues exert high levels of polyamines and activities of their bio synthetic enzymes, and encourage cell elongation herein produced the highest fruit weight and size on their study on pear trees (Fayek, Yehia, El-Fakhrany, & Farag, 2011; Yehia, S.Y. Mohamed, W.A., & S.H.M., 2009). Moreover, the fruit dimensions (dimeter and length) and firmness go in the same trend with fruit weight results. Where all present treatments significantly maintained fruit firmness than control. There positive effect by treating tree by high concentration of GA3 and B12.

Fruit chemical properties

It is cleared that, there are significant differences between the treatments in the SCC of 'Le-Conte' pear fruits (Table 2). The high concentration of GA3 and B12 gives the highest content of SSC% acidity however, the

increases in SCC% could be due to increase the accumulation of carbohydrate by effecting of B12 (E. E. El-Baz, El Eraky, Lo'ay, & El-Deeb, 2011). It is also noticeable that, the present treatments increased both of SSC and acidity but decreased SSC/acidity ratio, so it could be consider as a remark on GA3 and B12 effect.

It could be concluded from the present study that the application of combination of GA3 plus B12 at high concentrations (30 ppm and 4 mg L-1) improve vegetative growth, leaf chemical content, fruit quality and productivity of 'Le-Conte' pear trees compared with control treatment and other concentration treatments.

Table 1.Effect of GA3 and B12 on vegetative parameter, chlorophyll reading and C/N ratio on "Le-Cont' pear

Treatments	Shoot Length (cm)	Shoot diameter (cm)	Leaf area cm^2	C %	N %	C/N ratio	Chlorophyll SPAD reading
Control	101.01 e	0.90 f	26.53 e	32.36 g	1.72 e	15.99 g	43.11 f
GA3 15 ppm	117.83 d	0.97 e	28.52 d	34.18 f	1.85 de	17.11 f	45.26 e
GA3 30 ppm	124.66 cd	1.00 e	30.42 c	34.70 ef	1.91 de	18.11 e	45.85 de
Vit. B12 2 mg L-1	130.50 bcd	1.02 de	31.30 c	35.25 e	1.93 cd	18.60 d	46.19 de
Vit. B12 4 mg L-1	132.68 bcd	1.04 de	32.36 b	35.92 d	1.99 cd	18.89 d	46.77 d
GA3 15 + B12 2 mg L-1	137.08 bc	1.08 d	33.06 b	36.49 cd	2.10 bc	20.02 c	48.38 c
GA3 15 + B12 4 mg L-1	142.87 b	1.26 c	35.70 a	36.84 bc	2.18 b	21.66 b	51.45 b
GA3 30 + B12 2 mg L-1	157.63 a	1.52 b	35.83 a	37.29 b	2.62 a	22.13 a	51.62 b
GA3 30 + B12 4 mg L-1	163.22 a	1.64 a	36.73 a	38.84 a	2.73 a	22.52 a	53.29 a
LSD	14.73	0.06	1.05	0.62	0.17	0.45	1.09

Table 2. .Effect of GA3 and B12 on fruit prosperities parameter on "Le-Cont' pear

Treatments	Yield $tree^{-1}$ kg	Fruit weight g	Fruit volume cm^3	Fruit length cm	Fruit diameter cm	Fruit firmness	SSC %	Total Acidity	SSC/ TA ratio
Control	50.63 f	161.94 g	147 i	8.36 f	6.80 g	12.47 h	13.16 e	0.21 e	62.75 a
GA3 15 ppm	56.85 ef	177.61 f	157.5 h	8.53 ef	6.88 fg	12.71 g	13.30 de	0.22 de	60.45 ab
GA3 30 ppm	61.20 de	189.22 e	167.2 g	8.61 ef	6.94 ef	12.82 f	13.38 de	0.22 cd	59.92 bc
Vit. B12 2 mg L-1	65.75 cd	200.52 d	180.7 f	8.65 ef	7.02 de	12.04 f	13.46 de	0.23 c	59.84 bc
Vit. B12 4 mg L-1	70.74 c	205.30 c	185.1 e	8.80 de	7.13 cd	13.04 e	13.52 cde	0.23 c	59.21 bcd
GA3 15 + B12 2 mg L-1	84.33 b	209.32 b	190.7 d	9.04 d	7.22 c	13.18 d	13.57 cd	0.24 b	57.75 cd
GA3 15 + B12 4 mg L-1	108.18 a	219.27 a	197.6 c	9.54 c	7.62 b	13.53 c	13.84 bc	0.24 b	57.67 cd
GA3 30 + B12 2 mg L-1	113.76 a	219.92 a	200.9 b	9.99 b	7.96 a	13.80 b	14.19 b	0.25 a	56.76 d
GA3 30 + B12 4 mg L-1	114.40 a	220.65 a	208.1 a	10.70 a	8.06 a	14.10 a	15.24 a	0.25 a	60.21 bc
LSD	6.45	4.02	2.83	0.34	0.12	0.10	0.34	0.01	2.30

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تأثير رش الجبريللين و B_{12} بتركيزات و مواعيد مختليفة على العقد و المحصول و صفات جودة الثمار الكمثرى صنف الليكونت

اشرف عبد البارى عوضين

مركز البحوث البساتين الزراعية الجيزة القاهرة

أجريت هذه الدراسة خلال موسمي 2013 و 2014 لدراسة تأثير الرش على الأوراق لكل من GA3 (عند 15 و 30 جزء في المليون) و B12 (عند 2 و 4 ملغم لتر -1)، والتوليفات بينهما. تهدف الدراسة إلى تحسين نوعية ثمار أشجار الكمثرى الليكونت حيث تم الرش خلال مراحل تطور نمو الثمار من الازهار حتى العقد تم تطبيق المواد على تطوير مرحلة الفاكهة (حوالي 60 يوما بعد عقد الثمار) وتكررت بعد أسبوعين. وشملت القياسات: النمو الخضري، مساحة الورقة، المحتوى الكيميائي للأوراق، محصول الثمار وجودتها. المكونات المذكورة، ومن الملاحظ الاستجابات من الاشجار تحا الدراسة اذ يوصى رش الاشجاربتركيزعالىمن 30 GA3 جزء في المليون مع 4 ملجرام من B12 لتحسين الإنتاجية التي تزيد من دخل المزارعين. وبصفة عامة، حققت هذه الدراسة الهدف الرئيسي لمنتجي الفاكهة، وارتفاع المحصول، والجودة