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BETTER COMBINATION OF DEFOLIATION AND DORMANCY BREAKING AGENT FOR PEAR ORCHARDS

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ABSTRACT

This study was conducted during the 2004-2005 and 2005-2006 seasons to evaluate the effect of spraying "Le-Conte" pear (budded on *Pyrus communis* rootstock) trees with defoliation treatments (urea, 7% or zinc sulfate, 3.5%) at 1st Nov. or 15th Nov. and dormancy-breaking agents (hydrogen cyanamide, 49%; potassium sulfate or ammonium nitrate) sprayed at 1st Jan., 15th Jan. or 1st Feb. Measurements included vegetative growth (shoot length, number of leaves per shoot and percentage of vegetative spurs), floral growth (percentage of floral spurs and fruit set), fruit yield and its components (number of fruits/tree, fruit yield/tree and yield monetary value/tree) and fruit quality attributes (fruit weight and size as well as juice TSS and acidity).

Statistical analysis confirmed that, better results can be obtained as the follows combination of treatments. At 15th Nov. leaf shedding should spray using $ZnSO_4$ (3.5%). At the next 15th Jan., hydrogen cyanamide (49%) should spray on "Le-Conte" pear trees.

INTRODUCTION

"Le-Conte" pear is a hybrid between *Pyrus communis* and *P. serotina* and considered the main pear cultivar grown in Egypt, but it characterized by a distinct period of rest (endodormancy) which extends from late fall till early spring. Regrowth and flowering in the new season needs overcoming such dormancy (Westwood, 1978). However, management practices are important for lowering the chilling requirements of buds. These include controlling tree vigor, training to a horizontal tree form, preventing late vegetative growth, irrigation, fertilization, defoliation and delaying winter pruning (Lang *et al.*, 1987). Otherwise, treatment with dormancy-breaking agents is probably the most feasible alternative to control dormancy in deciduous fruit trees (Erez, 1995).

However, Dormex (49% hydrogen cyanamide; HC) application advanced flowering of apricot by 2-5 days (Son and Kuden, 2005). HC combined with mineral oil increased flower bud opening, advanced flowering and fruit set, increased the percentage of fruit set, fruit retention. number of fruits per tree, fruit yield, weight and volume (Brunton *et al.*, 2006). Spraying trees with KNO_3 was successful in breaking bud dormancy (Kuden *et al.*, 1995), increased bud GA3 level, advanced flowering and improved fruit TSS content (Shakweer, 2004).

Defoliation treatments with urea (10%) at 17/10 or 9/11 increased the percentage of pear fruit set (Ismail, 2001) and both application dates gave the same results (Stino, 1987). Moreover, zinc sulfate was more effective in advancing bud burst and increased apricot fruit set, yield and fruit diameter, weight and TSS than urea or control (Mahrous and El Fakharani, 2006).

Spray date	2004-2005		2005-2006	
	7.2ºC	10ºC	7.2ºC	10ºC
1 Jan.	21	143	13	127
15 Jan.	66	225	49	197
1 Feb.	79	265	54	243

Similar results were obtained with the use of HC on apple (Hasseeb and El Ezaby, 1995 and Ali *et al.*, 1997) or HC + mineral oil on pear (El Shall *et al.*, 1993) and KNO_3 or thiourea on pear (El Banna *et al.*, 1995).

Therefore, this study included spraying the pear trees with urea or zinc sulfate at 1 Nov. or 15 Nov. as defoliation treatments. The same trees were sprayed at 1 Jan., 15 Jan. or 1 Feb. with HC, potassium sulfate or ammonium nitrate as dormancy-breaking agents. The objective of this study was to establish the best combination of treatments to enhance flowering, increase yield and crop monetary value as well as to improve fruit quality.

MATERIALS AND METHODS

This research was conducted in El Qanater Res. Sta., Qallubia Governorate, Egypt, during the 2004-2005 and 2005-2006 seasons on "Le-Conte" pear budded on *Pyrus communis* rootstock. The trees were 12 years old, planted at 5 x 5 m in clay soil, received similar agricultural practices.

Defoliation treatments were urea (7%) or zinc sulfate (3.5%) at the 1st Nov. or 15th Nov. 2004 and 2005. Dormancy breaking agents were hydrogen cyanamide (HC) in the form of Dormex (49%), potassium sulfate or ammonium nitrate, which were sprayed at the 1st Jan., 15th Jan. or 1st Feb. 2005 and 2006. These treatments were used in a split-split plot system in a randomized complete block design with three replicates. Each experimental plot consisted of one tree.

Accumulated chilling hours at Giza location during Nov.-Mar. period of the 2004-2005 and 2005-2006 seasons using a base chilling temperature of either 7.2 or 10ºC were as follows:-

Data were recorded on vegetative growth (shoot length, number of leaves per shoot and vegetative spurs), as well as on floral growth (floral spurs and percentage of fruit set). At harvest time, number of fruit per tree and fruit yield per tree were recorded then used in estimating crop monetary value considering a farm-gate price of LE 2.5 per kg. Fruit quality attributes included, fruit weight, and size as well as juice TSS and titratable acidity as gm malic acid/100 gm fresh weight were recorded on 10 fruits per experimental unit (A.O.A.C., 1990).

The obtained data were subjected to analysis of variance according to Snedecor and Cochran (1990). Means were compared using the LSD test at the 5% level of probability.

RESULTS

1. Vegetative growth:

Vegetative growth included, shoot length and number of leaves per shoot (Table 1) as well as percentage of vegetative spurs (Table 2). Dormex breaking agent effectively increased shoot length and number of leaves per shoot followed by ammonium nitrate then potassium sulfate, where shoot length was 96.9, 92.6 and 87.8 cm. while number of leaves/shoot were 30.1, 27.4 and 26.2 respectively. Contrary, K_2SO_4 caused the highest percentage of vegetative spurs (17.0%) followed by ammonium nitrate (14.2%) then Dormex (10.6%). In continuation of that, we obtained the longest shoots (91.6 cm), the highest number of leaves per shoot (27.9) but the least percentage of vegetative spurs (9.9%) when we sprayed dormancy breaking agents at 15th Jan. followed by at 1st Feb. then 1st Jan. respectively. However, the differences mostly were insignificant.

Defoliation treatments with $ZnSO_4$ induced longer shoots (93.1 cm), more leaves (28.4) but less vegetative spurs (12.2%) than urea treatments. Moreover, defoliation applications were more effective when sprayed at 1st Nov. than 15th Nov.

If we consider the interaction effect, we can notice that, zinc sulfate helped pear trees to get into dormancy specially when sprayed at 1st Nov. then Dormex sprayed at 15th Jan. get the trees out of dormancy with longer shoots and higher number of leaves but less percentage of vegetative spurs.

2. Floral growth:

Percentage of floral spurs (Table 2) and fruit set (Table 3) used as an indicator of floral growth. However, it is noticeable that, hydrogen cyanamide induced higher percentage of both floral spurs (91.6 and 92.0%) and fruit set (5.9 and 6.0%) then both ammonium nitrate (87.2 and 88.1 as well as 5.0 and 5.1%) or K_2SO_4 (85.1 and 85.3 as well as 4.8 and 4.7%) in the two studied seasons respectively.

Spraying dormancy breaking agents at 15th Jan. get better floral spurs and fruit set than either 1st Jan. or 1st Feb. although the differences were not confirmed statistically.

Zinc sulfate as a defoliation spray deduced higher percentage of floral spurs (89.0 and 89.6%) and fruit set (5.6 and 5.5%) than urea (86.9 and 87.4% as well as 4.9 and 5.0%) through 2005 and 2006 seasons respectively. However, spraying defoliation treatments at 15th Nov. was more effective than at 1st Nov.

Interaction effect has a clear trend, hence $ZnSO_4$ spraying at 15th Nov. followed by hydrogen cyanamide at 15th Jan. increased floral spurs and fruit set percentage than other interactions.

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3. Fruit yield and its components:

Data illustrated in (Tables 3 and 4) showed a significant increase of number of fruits/tree (405 and 410), fruit yield/tree (80.2 and 81.4 kg) and yield monetary value/tree (LE 200.5 and 203.5) due to Dormex treatment in comparison with ammonium nitrate (375 and 370 fruits/tree; 72.8 and 71.8 kg fruits/tree as well as LE 182.0 and 179.5/tree) or potassium sulfate (337 and 345 fruits/tree, 65.0 and 66.8 kg fruits/tree as well as LE 162.5 and 167.0/tree) in both experimental seasons respectively.

In addition to, spray of dormancy breaking agent at 15th Jan. obtained better number of fruits (382 and 389), fruits yield (75.2 and 76.8 kg) and yield monetary value (LE 188.0 and 192.0) than the other spraying dates (1st Jan. and 1st Feb.) in both studied seasons respectively.

Furthermore, zinc sulfate significantly increased fruit yield and its components than urea specially when sprayed at 15th Nov. than 1st Nov.

Meanwhile, spray zinc sulfate (specially at 15th Nov.) consequent with Dormex (specially at 15th Jan.) increased number of fruits, fruit yield and yield monetary value than the other interactions.

4. Fruit quality attributes:

Fruit weight and size (Table 5) as well as juice TSS and acidity (Table 6) were assessed as an indicator to fruit quality attributes. The present data revealed that, Dormex treatments significantly increased fruit weight (198.0 and 198.5 g.) and size (196.1 and 196.0 cm^3) as well as juice TSS (12.6 and 13.1%) and also acidity (0.42 and 0.43%). Ammonium nitrate increased fruit weight (194.1 and 194.0 g.) and size (192.5 and 192.3 cm^3) but decreased juice TSS (11.7 and 12.4%) and acidity (0.34 and 0.32%) than K_2SO_4 (193.0 and 193.6 g.; 192.0 and 191.7 cm^3; 11.8 and 12.6% as well as 0.37 and 0.38%) in the two studied seasons respectively while the differences statistically were not confirmed.

Tables 5 and 6 showed that, bigger fruit in weight (196.9 and 197.9 g.) and size (194.6 and 196.0 cm^3) as well as higher juice TSS (12.4 and 13.0%) but not acidity were obtained when the tested dormancy breaking agents were sprayed at 15th Jan.

Zinc sulfate as a defoliation agent induced better fruit weight (197.9 and 198.5 g.) and size (195.4 and 195.5 cm^3) but less juice TSS (11.7 and 12.4%) specially when sprayed at 15th Nov. than at 1st Nov. and than urea treatments while fruit juice acidity did not attain clear trend.

If we consider the interactions effect, the pear fruit weight and size respond better to zinc sulfate when was sprayed at 15th Nov. then hydrogen cyanamide was sprayed at 15th Jan. in the two studied seasons.

4

DISCUSSION AND CONCLUSIONS

From the above mentioned results, we can conclude that, vegetative growth (shoot length, number of leaves per shoot and percentage of vegetative spurs), floral growth (percentage of floral spurs and percentage of fruit set), fruit yield and its components (number of fruits/tree, fruit yield/tree and yield monetary value/tree) and fruit quality attributes (fruit weight and size, as well as juice TSS and acidity) positively responded to the present treatments. Defoliation treatments with zinc sulfate induced longer shoots, more leaves, higher percentage of floral spurs and fruit set, increased number of fruits/tree, fruit yield and yield monetary value as well as fruit weight and size than studied urea application. However, urea caused higher percentage of vegetative spurs and higher juice TSS, while juice acidity did not attain clear trend. Furthermore, leaf shedding at 1st Nov. enhanced vegetative growth, while at 15th Nov. encouraged floral growth, fruit yield and its components and fruit quality attributes. Meanwhile, treatment of zinc sulfate was more effective in advancing bud burst and increasing fruit set, yield and fruit diameter, weight, firmness and TSS than urea or control of peach (Lioyd and Firth, 1990) and apricot (Mahrous and El Fakharani, 2006). Moreover, Stino (1987) reported that, date of pear leaf shedding is insignificant hence both dates gave the same results; while peach early defoliation reduces depth of bud dormancy throughout the winter (Lioyd and Firth, 1990). The same trend was reported by El Shall *et al.* (1993), El Banna *et al.*, (1995) and Ismail (2001) on pear trees.

Hydrogen cyanamide applications recorded the highest vegetative and floral growth, fruit yield, crop monetary value and fruit quality attributes, except vegetative spurs which attained the highest percentage as a result of K_2SO_4 treatments. Besides, ammonium nitrate treatment was more effective than K_2SO_4 with all studied attributes but decreased fruit juice TSS and acidity than potassium sulfate treatment. Accordingly, we get better response when the dormancy breaking agents sprayed at 15th Jan. followed by 1st Feb. then 1st Jan. respectively except with the percentage of vegetative spurs which were highest with 1st Jan. and with fruit juice acidity which was least with 1st Feb. applications.

Prior studies reported that, hydrogen cyanamide treatments (HC) advanced flowering of apricot (Son and Kuden, 2005) increased flower bud opening, increased fruit set, fruit retention, number of fruits, fruit yield, weight and volume (Brunton *et al.*, 2006). However, El Shall *et al.* (1993) and Holwah and El Sheikh (2000) showed that, opening of “Le-Conte” pear buds were corresponded positively with the increase in chilling units, bud ABA content decreased rapidly from January to March, while GA_3 content increased during February., as well as IAA content increased from its minimum level in February to its maximum at bud burst. Also, Shakweer (2004) explained that, auxin and GA_3 level increased markedly in control apricot trees during the period from bud dormancy (10th Feb.) to bud break

(9-20th March) while HC treatments achieved 19-fold increase in IAA level within 8 days from application.

Henceforth, we can conclude the best combination practice in "Le-Conte" pear orchards. Also, we can recommend pear growers to defoliate foliage using zinc sulfate (3.5%) sprays at 15th Nov. concomitant with spray hydrogen cyanamide (49%) at 15th Jan. That interaction will induce better vegetative and floral growth, consequently enhance fruit yield, crop monetary value and also fruit quality attributes.

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توليفة مفضلة لإسقاط الأوراق ثم كسر سكون البراعم فى مزارع الكمثرى

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نفذت هذه الدراسة خلال موسمي ٢٠٠٤-٢٠٠٥,٢٠٠٥-٢٠٠٦ لتقدير تأثير رش أشجار الكمثري صنف ليكونت(المطعومة علي أصل بيرس كميونس) بمركبات مسقطة للأوراق (٧% يوريا أو ٣,٥% سلفات زنك) يوم ١ نوفمبر أو ١٥ نوفمبر ثم رش نفس الأشجار بمركبات كاسرة للسكون(سينامید الهيدروجين أو سلفات البوتاسيوم أو نترات الأمونيوم) يوم ١ يناير أو ١٥يناير أو ١ فبراير. شملت الصفات التي تم تقديرها النمو الخضري (طول الفرع - عدد الأوراق/الفرع - %للدوابرالخضريه) والنمو الزهري (%للدواير الزهريه - %لعقد الثمار) ومحصول الثمار (عدد الثمار/الشجرة - محصول الشجرة - القيمة النقدية للمحصول) وكذالك صفات الجودة (وزن الثمرة - حجم الثمرة - %للمواد الصلبة الذائبة الكلية - %لحموضه العصير).

أثبت التحليل الإحصائي أنه يمكن الوصول لأفضل النتائج بإتباع هذه التوليفة من المعاملات : يوم ١٥ نوفمبر ترش الأشجار ب٣,٥%سلفات الزنك لإسقاط الأوراق وفي يوم ١٥ يناير ترش نفس الاشجار بسينامید الهيدروجين (٤٩%) كمادة كاسرة للسكون.