

Effect of Spraying Garlic Extract and Olive Oil on Flowering Behavior, Yield and Fruit Quality of 'Canino' Apricot Trees

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Abstract: Canino apricot trees were sprayed once (mid January) after winter pruning at dormant bud stage with materials: (1) 4% garlic extract (2) 4% garlic extract + 1% olive oil (3) 4% garlic extract + 2% olive oil (4) 1% olive oil (5) 2% olive oil (6) 2 % hydrogen cyanamide (as synthetic chemical product) (7) control (spraying with water only). Treatments were compared with control and other synthetic chemical product to study the effect of natural substances on flowering behavior, yield and fruit quality of Canino apricot trees. Results showed that, garlic extract and olive oil treatments achieved earlier full bloom than the control, while there was no signification in full bloom time was noticed between spraying with these natural substances and hydrogen cyanamide. All treatments had higher flowering percentage and produced higher yield than the control. Olive oil at 2% achieved the highest yield compared with all other treatments; similar trend was obtained by olive oil 1%. However, the control recorded the lowest yield. Fruit weight, volume and dimensions were increased by all treatments than the control. The highest fruit flush weight was obtained by 2% olive oil. Fruit TSS % was increased, while acidity as well as firmness was decreased by all treatments compared with control. Spraying olive oil at 2% is recommended to improve productivity and fruit quality of Canino apricot trees.

Key words: Apricot • Garlic extract • Olive oil • Flowering • Yield • Fruit Quality

INTRODUCTION

Apricot (*Prunus armeniaca*) is an important fruit crop that believed to have originated in China. In Egypt, the total cultivated area of apricot trees is 18061 feddan (one feddan = 4200 m²) which produced about 6.81 tons/feddan and the total production reached about 106165 tons [1]. The use of natural products in horticultural practices instead of synthetic chemical products is becoming as a main target for many fruit crop producers, where the world market has been growing rapidly in recent years for organic fruit production [2]. Chemical bud break agents are not authorized for use in organic fruit production [3]. In this respect, the chemical analysis of garlic cloves has revealed a high concentration of sulfur compounds 1-3% [4]. The active substances in garlic cloves are represented in sulfur compounds and they are responsible for breaking bud dormancy in grapevine and their effects varied among the concentration and the duration of exposure [5].

Substances with the sulfur molecules are interrupting the dormancy-breaking of different species of deciduous plants [6]. The action mechanism of dormancy-breaking compounds has been investigated, so far, a sharp increase in respiration rate was observed within 15 hr after H₂S, ally sulfide or garlic vapour treatment of dormant tubers of platycodon [7]. Previous reports stated that "extracts from garlic (*Allium sativum* L.) or past prepared from fresh garlic induces breaking of dormancy when applied to grapevine" [8, 9], as well as, when applied to apple [10] and peach [11]. Moreover, oil was responded for braking dormancy due to its effect, which caused an increase in respiration rate of buds in peach trees [11].

In the present study, garlic extract and olive oil were evaluated as natural products for bud break of "Canino" apricot trees to obtain early full bloom and improve flowering percentage, yield and fruit quality compared with synthetic chemical products since, the use of natural products in horticultural practices became as a main target for many fruit producers.

MATERIALS AND METHODS

The present study was conducted during two successive seasons (2009 and 2010) on 'Canino' apricot trees budded on seedling rootstocks at a private orchard of El-Kotab & El-Mufakiren village located at Cairo-Alexandria Desert Road, Egypt. Trees were about 12 years old, planted at 5 x 5 m apart in sandy soil under drip irrigation system. The selected trees were healthy, uniform in shape and size and received their normal cultural practices that usually applied in commercial orchards. A complete randomized block design was used. The following spraying treatments were investigated:

- Garlic extract (GE) at 4%.
- GE at 4% + olive oil 1%.
- GE at 4% + olive oil 2%.
- Olive oil 1%.
- Olive oil 2%.
- Hydrogen cyanamide at 2%.
- Control (spraying with water only).

The garlic extract was prepared from 100 g of fresh peeled cloves, mashed in a porcelain mortar [12], then it crushed in 0.5 L distilled water using a mixer, filtered and descanted by distilled water to 1 L to obtain 10 % garlic extract concentration that was diluted to get 4%. Olive oil was emulated in water at 1 or 2% as described by Abd El-Kader *et al.* [13]. Eighty four trees (healthy and uniform) were chosen for this experiment. Each treatment was replicated four times where three trees per each replicate. The trees were sprayed at dormant bud stage (mid January) in each season with the abovementioned solution till run off. Triton wetting agent at 0.1% concentration was added to all spraying solutions including the control. The following parameters were recorded through this investigation:

Flowering Behavior:

- Full bloom date: period in days beginning from time of spray (mid January) to full bloom (50% flowering) [14].
- Flowering percentage: four branches from each side of the tree were selected and labeled then it was calculated as the following equation:

$$\text{Flowering \%} = \left(\frac{\text{No. of flowering buds}}{\text{total No. of buds}} \right) \times 100 \text{ [14].}$$

Yield: It expressed as weight of fruit/tree (Kg) attained at harvest stage at the end of May.

Fruit Physical Characteristics: Sample of 30 mature fruits were taken from each replicate tree of each treatment and determined the following physical characteristics: fruit weight (gm), fruit volume (cm³), specific gravity (gm/cm³), fruit dimension as length and width (cm) and fruit shape index (L/W), fruit firmness (Lb/inch²) by using a pressure tester 5/16 inch plunger.

Fruit Chemical Characteristics: A juice of fruit samples were used to determine chemical characteristics: total soluble solids (TSS %) by using a hand refractometer, fruit acidity and TSS/Acid ratio [15].

Statistical Analysis: Data were subjected to analysis of variance and the method of Duncan's was used to differentiate means [16].

RESULTS

Flowering Behavior

Full Bloom Date & Flowering %: Table 1 presents the effect of spraying garlic extract and olive oil on full bloom date, flowering % and yield during 2009 and 2010. As for full bloom date, results show that all treatments achieved earlier full bloom than the control during the two seasons. The mean of two seasons reveal that olive oil 2% recorded the earlier date (61 days from spraying) than the control (78 days), while garlic extract 4% in combined with olive oil at 1% or 2% achieved (67 days). Moreover, there was no signification concerning full bloom date between natural substances (61-67 days) and hydrogen cyanamide 2% (64 days).

Regarding flowering percentage, the results in Table (1) indicate that all treatments had higher flowering percentage over the control during the two seasons. The mean of the two seasons confirmed that olive oil 2% had the highest percentage of flowering (31.4 %). On the other side, the control trees had the lowest flowering percentage (17.39 %).

Yield: It is clear from the results in Table 1 that all treatments produced higher yield than control. Mean of the two season's shows that the highest yield (44.04 kg/tree) was obtained by spraying olive oil 2%. Spraying olive oil at 1% came in the second order (39.51 kg/tree) followed by hydrogen cyanamide at 2% (36.21 Kg/tree). In

this respect, olive oil treatments achieved higher yield than hydrogen cyanamide. The lowest yield was recorded by control (29.67 kg/tree).

Fruit Physical Characteristics

Fruit Weight, Volume and Specific Gravity: Data presented in Table 2 showed that the fruit weight, volume and specific gravity of 'Canino' apricot as affected by different treatments. Concerning the fruit weight, all treatments produced heavier fruit than the control in both seasons. Spraying olive oil at 2% had the heaviest fruit (45.2 g) in the first season. In contrast, control gave the lowest fruit weight (30.78g). In the second season, garlic extract at 4% gave the heaviest fruit (44.78 g). On the other side, the lowest fruit weight (29.78 g) was obtained by control. The mean of two years confirmed the same trend of the second season. Regarding fruit volume, data in Table 2 indicated that all treatments had fruit volume bigger than the control. In the first season, fruit volume ranged from 37.78 to 45 cm³. On the other hand, control treatment had the smallest fruit volume (30 cm³). In the second season, garlic extract 4% alone as well as olive oil at 1% or 2% and hydrogen cyanamide 2% produced higher fruit volume (44.44, 37.22, 44.44 and 39.44 cm³, respectively) compared with the control (27.78 cm³). Generally, the mean of two seasons confirmed the same trend of the second season. As for fruit specific gravity, the mean of the two seasons in Table (2) reveal that control gave the highest value (1.07 g/ cm³). All treatments had low specific gravity due to the increase of fruit volume which more improved than of fruit weight (specific gravity of them ranged between 0.93 and 0.97 g/ cm³).

Fruit Dimension and Shape Index: The data in Table (3) present the effect of spraying garlic extract and olive oil on fruit length, width and shape index. Concerning fruit

length, results in 2009 and 2010 as well as the mean of the two seasons cleared a similar trend that olive oil at 2% increased fruit length (4.47 cm) than all treatments; the lowest fruit length (3.84 cm) was detected by the control. Regarding fruit width, results in Table 3 clear that in both studied seasons and the mean of the two season's show that all treatments had higher fruit width compared with the control. As for fruit shape index, Table 3 revealed that in 2009 season, there were no significant differences among treatments including the control except olive oil at 2% produced elongated apricot fruits (1.05 L/W), while garlic extract at 4% and hydrogen cyanamide produced flatted ones (0.98 and 0.99 L/W, respectively). However, in 2010 season, all treatments gave elongated fruits that varied between different treatments, the higher elongated fruits where obtained from control treatment. Mean of the two seasons followed the same trend obtained by different treatments in the second seasons except garlic extract at 4% produced round fruits (1.00 L/W).

Seed Weight, Fruit Flush Weight and Firmness:

Concerning seed weight, Table 4 revealed that all treatments had no effect on seed weight in the first season. Results showed that all treatments insignificantly decreased seed weight compared with the control except garlic extract at 4% + olive oil 1%, garlic extract at 4% + olive oil 2% and olive oil 1% treatments in the second season and garlic extract at 4% + olive oil 2% significantly decreased seed weight than the control in mean of two season. It is clear from Table 4 that fruit flush weight was increased significantly by all treatments compared with the control in 2009 and 2010 seasons. The highest values of fruit flush weight was obtained from olive oil 2% and garlic extract 4% in the first and second season respectively. However, highest fruit flush weight in mean of two seasons was obtained from fruits taken from trees sprayed olive oil 2%. Table 4 demonstrated that control

Table 1: Effect of spraying garlic extract and olive oil on full bloom date, flowering percentage and yield of 'Canino' apricot trees.

Treatments	Full bloom date (No. days from spraying)			Flowering (%)			Yield (kg/tree)		
	2009	2010	Mean	2009	2010	Mean	2009	2010	Mean
GE 4%	64 bc	66 bc	65 bc	24.72 b	25.64 b	25.18 b	34.31 c	35.73 c	35.02 c
GE 4% + OO 1%	65 b	68 b	67 b	21.62 b	23.85 b	22.74 b	34.33 c	37.14 c	35.74 c
GE 4% + OO 2%	66 b	68 b	67 b	22.13 b	25.15 b	23.64 b	34.61 c	37.11 c	35.86 c
OO 1%	63 bc	66 bc	65 bc	25.50 b	26.06 b	25.78 b	38.54 b	40.48 b	39.51 b
OO 2%	59 c	62 c	61 c	30.77 a	32.03 a	31.40 a	43.12 a	44.96 a	44.04 a
CH ₂ N ₂	62 bc	65 bc	64 bc	24.86 b	26.38 b	25.62 b	35.91 c	36.50 c	36.21 c
Control	76 a	79 a	78 a	16.38 c	18.39 c	17.39 c	29.19 d	30.15 d	29.67 d

(GE) Garlic Extract; (OO) Olive Oil; (CH₂N₂) Hydrogen cyanamide. Means within a column followed by different letter (s) are statistically different at 5 % level by Duncan's multiple range test.

Table 2: Fruit weight, volume and specific gravity as affected by garlic extract and olive oil spraying of 'Canino' apricot trees.

Treatments	Fruit weight (gm)			Fruit volume (cm ³)			Specific gravity (g/ cm ³)		
	2009	2010	Mean	2009	2010	Mean	2009	2010	Mean
GE 4%	37.67 b	44.78 a	41.23 ab	41.11 a	44.44 a	42.78 a	0.92 ab	1.01 ab	0.97 b
GE 4% + OO 1%	36.40 b	34.78 d	35.59 c	38.89 a	35.56 b	37.22 b	0.94 ab	0.98 ab	0.96 b
GE 4% + OO 2%	36.40 b	34.22 d	35.34 c	37.78 a	36.11 b	36.95 b	0.94 ab	0.95 ab	0.95 b
OO 1%	40.30 ab	36.22 cd	38.26 bc	43.89 a	37.22 ab	40.56 ab	0.95 ab	0.97 ab	0.96 b
OO 2%	45.20 a	43.33 ab	44.27 a	45.00 a	44.44 a	44.72 a	1.00 ab	0.93 b	0.97 b
CH ₂ N ₂	40.00 ab	39.67 bc	39.84 abc	45.00 a	39.44 ab	42.22 ab	0.89 b	0.97 ab	0.93 b
Control	30.78 c	29.78 e	30.28 d	30.00 b	27.78 c	28.89 c	1.06 a	1.07 a	1.07 a

(GE) Garlic Extract; (OO) Olive Oil; (CH₂N₂) Hydrogen cyanamide. Means within a column followed by different letter (s) are statistically different at 5 % level by Duncan's multiple range test.

Table 3: Fruit quality: fruit length, width and shape index as affected by garlic extract and olive oil spraying of 'Canino' apricot trees.

Treatments	Fruit Length (cm) L*			Fruit width (cm) W*			Shape Index (L/W)*		
	2009	2010	Mean	2009	2010	Mean	2009	2010	Mean
GE 4%	4.21 b	4.24 b	4.23 b	4.24 a	4.16 a	4.20 a	0.98 b	1.02 b	1.00 d
GE 4% + OO 1%	4.28 b	4.12 bc	4.20 b	4.22 a	3.94 cd	4.08 ab	1.01 ab	1.07 ab	1.04 abcd
GE 4% + OO 2%	4.21 b	4.09 bc	4.15 b	4.11 a	3.76 d	3.94 b	1.03 ab	1.09 ab	1.06 abc
OO 1%	4.27 b	4.01 c	4.14 b	4.21 a	3.91 bcd	4.06 ab	1.02 ab	1.03 b	1.02 bcd
OO 2%	4.50 a	4.44 a	4.47 a	4.28 a	4.11 ab	4.19 a	1.05 a	1.08 ab	1.07 ab
CH ₂ N ₂	4.27 b	4.22 b	4.25 b	4.33 a	4.07 abc	4.20 a	0.99 b	1.04 b	1.01 cd
Control	3.97 c	3.71 d	3.84 c	3.86 b	3.33 e	3.59 c	1.03 ab	1.12 a	1.08 a

(GE) Garlic Extract; (OO) Olive Oil; (CH₂N₂) Hydrogen cyanamide. Means within a column followed by different letter (s) are statistically different at 5 % level by Duncan's multiple range test.

Table 4: Seed weight, fruit flush weight and fruit firmness as affected by garlic extract and olive oil spraying of 'Canino' apricot trees.

Treatments	Seed weight (g)			Fruit flush weight (g)			Fruit firmness (Lb/ inch ²)		
	2009	2010	Mean	2009	2010	Mean	2009	2010	Mean
GE 4%	2.44 a	2.67 ab	2.56 ab	35.22 ab	42.11 a	38.67 ab	4.17 bc	4.17 bc	4.17 c
GE 4% + OO 1%	2.89 a	2.33 bc	2.61 ab	33.56 bc	32.44 cd	33.00 c	5.42 b	4.67 b	5.04 bc
GE 4% + OO 2%	2.56 a	2.00 c	2.28 b	33.89 bc	32.44 cd	33.06 c	5.67 b	6.33 b	6.00 b
OO 1%	2.78 a	2.00 c	2.39 ab	37.56 ab	34.22 bc	35.89 bc	5.50 b	6.17 b	5.83 b
OO 2%	3.00 a	2.67 ab	2.83 ab	42.22 a	40.67 ab	41.44 a	3.33 c	4.67 b	4.00 c
CH ₂ N ₂	3.00 a	2.56 abc	2.78 ab	37.00 ab	37.11 abc	37.06 abc	5.33 b	4.83 b	5.08 bc
Control	2.89 a	3.11 a	3.00 a	27.89 d	26.67 e	27.28 d	7.67 a	9.17 a	8.42 a

(GE) Garlic Extract; (OO) Olive Oil; (CH₂N₂) Hydrogen cyanamide. Means within a column followed by different letter (s) are statistically different at 5 % level by Duncan's multiple range test.

Table 5: TSS, acidity and TSS/acid ratio as affected by garlic extract and olive oil spraying of 'Canino' apricot trees.

Treatments	TSS (%)			Acidity (mg/gm)			TSS/acid ratio		
	2009	2010	Mean	2009	2010	Mean	2009	2010	Mean
GE 4%	16.00 a	17.00 a	16.50 a	0.90 b	1.16 b	1.03 b	18.44 b	16.36 a	17.40 b
GE 4% + OO 1%	15.67 a	16.33 a	16.00 a	0.94 b	0.92 b	0.93 bc	16.70 bc	17.92 a	17.31 b
GE 4% + OO 2%	15.50 a	16.33 a	15.92 a	1.00 b	1.05 b	1.03 b	15.47 bc	15.79 a	15.63 b
OO 1%	15.77 a	15.67 a	15.71 a	0.98 b	1.13 b	1.06 b	16.68 bc	14.88 ab	15.78 b
OO 2%	16.67 a	16.00 a	16.33 a	0.55 c	0.87 b	0.72 c	31.02 a	18.91 a	24.96 a
CH ₂ N ₂	16.00 a	16.00 a	16.00 a	1.15 b	1.07 b	1.11 b	14.01 bc	15.10 ab	14.56 b
Control	13.00 b	13.33 b	13.17 b	1.41 a	1.66 a	1.54 a	9.28 d	8.03 c	8.66 c

(GE) Garlic Extract; (OO) Olive Oil; (CH₂N₂) Hydrogen cyanamide. Means within a column followed by different letter (s) are statistically different at 5 % level by Duncan's multiple range test.

had the highest significant value of fruit firmness during the two seasons. Generally, olive oil at the high concentration (2%) decreased fruit firmness than olive oil at the low concentration (1%). In the contrary, garlic extract combined the high concentration of olive oil (2%) tended to slightly increase fruit firmness.

Fruit Chemical Characteristics: Table 5 shows the effect of different treatments on T.S.S%, acidity and T.S.S/acid ratio of Canino apricot fruits. As for T.S.S, it is evident that T.S.S % in fruits was increased by all treatments (mean of the two seasons ranged between 15.71 and 16.5 %) compared with control (13.17%).

Concerning acidity, Table 5 points out that acidity was decreased by all treatments compared with the control in 2009 and 2010 seasons. The highest value of fruit acidity was recorded by control (mean of two seasons, 1.54 mg/g). On other hand, the lowest value of fruit acidity was obtained by olive oil 2% (mean of two seasons, 0.72 mg/g). TSS/acid ratio was significantly increased by different treatments compared with the control during the two seasons (Table 5). The mean of two seasons indicted that the highest TSS/acid ratio (24.96) was recorded by olive oil 2% treatment. On the other side, control fruits had the lowest TSS/acid ratio (8.66).

DISCUSSION

The general positive effects of spraying garlic extract and olive oil alone or in combination observed on flowering behavior, yield and some physical and chemical characteristics of 'Canino' apricot fruit could be attributed to enhancement effects of these applied substances which caused early full bloom, increasing flowering percentage which consequently increases of yield. In this study, garlic extract and olive oil were responsible for breaking bud that improved flowering percentage, yield as well as fruit characteristics [11]. Similar results were reported in previous studies stated that "extracts from garlic (*Allium sativum* L.) or past prepared from fresh garlic induces breaking of dormancy when applied to grapevine" [8, 9], apple [10] and peach [11] and oil treatments when applied on peach [11]. In addition, accumulating evidences have confirmed the results of this study of garlic extract and oils that are effective for breaking bud dormancy in grapevine and different species of deciduous plants [4-6]. Moreover, many previous studies are in parallel with the result of this study and reported that the action mechanism of sulfur compounds

in garlic extract caused dormancy-breaking [7] as well as oil when applying on peach trees [11].

Generally, the results of this study reached the main target for many fruit producers concerning the use of natural products such as garlic extract and olive oil as our study in bud breaking dormancy instead of synthetic chemical products such as hydrogen cyanamide, where the world market has been growing rapidly in recent years for organic fruit production [2] since the chemical bud break agents are not authorized for use in organic fruit production [3]. As fruit characteristics, garlic extract treatment improved quality by producing round fruits. When garlic extract companied with olive oil fruit quality improvement was achieved by increased fruit flush weight and decreased seed weight. The present investigation cleared that the natural sprayed materials improved fruit quality of Canino apricot. In this respect, spraying olive oil alone resulted low firmness, low acidity and high T.S.S concentration. It is interest to notice the beneficial effects of garlic extract on improve fruit quality where, the presence of garlic extract with olive oil spray improved fruit firmness comparing with spraying olive oil individually. Our abovementioned results cleared that spraying garlic extract and olive oil had a positive effect on fruit physical and chemical characteristics, these effects were agreed with results obtained by Ahmed *et al.* [11] who reported that peach fruits treated with garlic extract and mineral oil reached higher sugar content.

CONCLUSION

It could be concluded from the present study that 'Canino' apricot trees grown under warm winter conditions greatly responded to spraying garlic extract at 4% and olive oil 1% & 2% alone or in combination which improve productivity and fruit quality. Generally, this study achieved main target for fruit producers through using natural products for breaking bud dormancy instead of synthetic chemical products such as hydrogen cyanamide.

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