

Effect of Some Breaking Dormancy Agents on Fruiting of Some Pomegranate Cultivars

M. Abou El-Wafa

Olive and Semi-Arid Fruits Zone Research Department, Horticulture Research Institute,
Agriculture Research Centre, Giza, Egypt

Abstract: A field experiment was carried out during two successive seasons of 2018 and 2019 on pomegranate trees grown in a private orchard, Giza Government, Egypt. The aim of this investigation was to study the effect of dormancy breaking agent on fruiting of some pomegranate cultivars. The field experiment included three pomegranate cultivars (H116, Manfalouty and Wonderful) and two dormancy breaking compounds, natural oil (garlic oil and jasmine oil) and hydrogen cyanamide, the treatments included eighteen treatments per cultivar, arranged as: control (untreated), hydrogen cyanamide at (2 and 3%), jasmine oil at (0.2 and 0.3%), garlic oil at (2 and 3%), hydrogen cyanamide at 2% + jasmine oil at 0.3% and hydrogen cyanamide at 2% + garlic oil at 3%. Tested trees under investigation were divided into two groups first was sprayed once per tree at 15th January and second group was sprayed once per tree at 1st February. The results revealed that each of foliar application with dormex and jasmine oil alone or combinations gave the significantly effect in early bud burst and harvest. In addition, the treatment with dormex at 3% was more effective than the other treatments and leading to achieve higher profitability. In addition, H116 cultivar was earliest cultivar in opening the bud and harvest. While, Wonderful cultivar gave the highest value in number of fruits, fruit weight (g), fruit yield (kg/tree), fruit length and fruit width (cm). Thus, it can be recommended that, treatment with hydrogen cyanamide alone or combination with jasmine oil on 15th January could be a suitable for pomegranate fruits under Giza governorate climatic conditions.

Key words: Pomegranate Hydrogen cyanamide • Jasmine Oil • Garlic Oil

INTRODUCTION

Pomegranate is mainly grown in tropical and subtropical areas of the world. High quality fruits can be produced where there is cool winter and warm hot dry summer [1, 2]. There is a variation range of chilling requirement among pomegranate cultivars ranged from 233 to 633 hours [3]. Dormancy is the phase of development that occurs annually in deciduous fruit trees [4]. Release from dormancy requires a chilling period during winter followed by a temperature rise in spring [5]. Since, the winter in Egypt is short and does not meet the requirements of the buds from chilling units. So, Pomegranate cultivars that grown under this condition have an irregular budding and flowering, that demonstrating to un adapted to climatic condition. Under the inadequacy of accumulated cold hours, the use of some products that causes dormancy breaking and act

as a sprouting inducers to complete chilling requirements is very important to improve level of bud breaking and advancing bloom, vegetative bud development flowering and yield [6].

Hydrogen cyanamide (dormex) is used in the case of lack of sufficient cold hours in the winter and when it is needed to standardize and anticipate sprouting. This leads to early harvest, which is related to the effects on respiratory system of cells and the interference with some enzyme activity that control the plant's rest, such as the catalase activity [7, 8].

Recently researchers have shown an interest in the application of non-toxic alternatives instead of synthetic chemicals as dormancy breaking agents of fruit trees to improve plant growth [9]. Using a natural products becoming the main target for many fruit crop producers, where the world market has been growing rapidly in recent years for organic fruit production.

Jasmine oil is one of the essential oils that may have a role as protective substances against stress [10]. Essential oils may slow some vital processes, while enhance juvenility, lowering consumption of sugars by hindering ethylene action and retarding the quick senescence of plant organs and in turn utilization of sugars [11].

Garlic oil is a natural product that works as an alternative for dormancy breaking agents of temperate climate fruit trees, mainly for alternative production systems, which restricts the use of agrochemicals [12, 13]. The hypothesis of using this product is based on the presence of sulfur compounds such as di allyl di sulfide, which play the main role as dormancy-breaking agent of different species of deciduous plants [14, 15].

Thus, the main objective of this investigation was to study the effect of Hydrogen cyanamide (dormex) and natural oil on some pomegranate cultivars (H116, Manfalouty and Wonderful) to produce early and high quality fruits pomegranate cultivar under Giza climatic conditions.

MATERIALS AND METHODS

Field Experiment: This investigation was under taken during 2018 and 2019 growing seasons to study the influence of spraying with some breaking dormancy agent on fruiting of some pomegranate cultivars. The selected trees were planted at 5 m x 3 m apart in sandy soil under drip irrigation system in a private orchard located at Alexandria desert road, Giza Governorate, Egypt. The trees were about four years old uniform in vigor as possible and received the same horticultural practices that are recommended by The Egyptian Ministry of Agriculture.

Lay out of Experiment and Treatments: The experiment was set a factorial experiment and it's included three factors:

- Cultivars: three of pomegranate cultivars (H116, Manfalouty and Wonderful) were subjected in this study.
- Dates of spraying: the tested trees of each cultivar was divided into two groups first, sprayed in the mid of January and the second sprayed in the first of February at dormant bud stage.
- Dormancy breaking agent: After winter pruning, two dormancy breaking compounds, natural oil (garlic oil

and jasmine oil) and hydrogen cyanamide (48%) were sprayed alone or in combination during the two seasons of study as follow:

- Control (untreated)
- Hydrogen cyanamide (dormex) at 2%
- Hydrogen cyanamide (dormex) at 3%
- Jasmine oil at 0.2%
- Jasmine oil at 0.3%
- Garlic oil at 2%
- Garlic oil at 3%
- Hydrogen cyanamide (dormex) at 2% + jasmine oil at 0.3%
- Hydrogen cyanamide (dormex) at 2% + garlic oil at 3%

Furthermore, the treatments were arranged in a completely randomized design with three replicates for each treatment and each replicate was represented by one tree.

Chemical analysis of garlic and jasmine oils were carried out according to the methods of Lanzotti [16, [17] and Kittikorn and Kanlayanarat, [18], respectively, as shown in Tables (1 and 2).

Field observations and laboratory measurements were achieved and conducted out over the periods of this research as follows:

Morphological Characteristics

Date of Bud Burst and its Percentage: Date of bud burst was recorded at the beginning of bud burst. The numbers of buds were counted (at the last week of February) to calculate the percentage of bud burst according to the following equation:

$$\text{Bud burst \%} = \frac{\text{Number of open buds/shoot}}{\text{Total number of buds/shoot}} \times 100$$

Fruiting and Yield: Date of commencement of harvest, this stage was obtained when the fruits reached the marketable maturity stage, the date of full bloom and harvesting date were recorded for each treatment and then number of days from full bloom to harvesting date were calculated. Also, total number of fruits per tree and fruit weight (g) was determined then total yield per tree (Kg) was estimated.

Fruit Physical Characteristics: A sample of ten ripped fruits was randomly harvested for determining average fruit length and diameter (cm).

Table 1: Chemical analysis of garlic oil

Values	Components	Values	Components
2.65	2-Vinyl-4H-1, 3-dithiin (%)	3.2	Protin (%)
4.12	3, 3-Thiobis-1-Propene (%)	0.1	Fat (%)
0.43	Methyl-propenyl- disulfide (%)	13.8	Carbohydrates (%)
23.53	allicin (%)	0.4	Fiber (%)
21.98	Diallyl disulfide (%)	81.5	Ash (%)
6.31	Di-2-propenyl tri sulfide (%)	220	Ca (%) (mg)
17.43	Dimethyl –tri sulfide (%)	1	Fe (mg)
6.76	Eugenol (%)	11	Mg (mg)
2.65	Diallyl tetra sulphide (%)	79	P (mg)
0.32	Diallyl penta sulfide (%)	212	K (mg)
0.13	Methyl allylpenta sulfide (%)	1	Zn (mg)
3.93	B-caryophyllene (%)	5.87	Methyl allylhexa sulfide (%)

Table 2: Chemical analysis of jasmine oil

Values	Constituent	Values	Constituent
25-30	Benzyl acetate %	17-20	Benzyl benzoate %
7-10	Cis- jasmine %	7-13	Phytol %
5-7	Methyl anthranilate %	3-5	Linalool %
3-5	Geraniol %	1	Indol %

Fruit Juice Chemical Composition:

- Total soluble solids (TSS) were determined by hand refractometre.
- Total acidity percentage was determined by titrating 5 ml juice against 0.1 NaOH using phenolphthalene as an indicator. The values of total acidity were expressed in grams of citric acid per 100 ml juice as described in A. O. A. C. [19], then, T.S.S/acid ratio was calculated.
- Total anthocyanin content (%) was determined in fruit juice as described by Hsia *et al.* [20].

Economic Evaluation: Economics evaluation /feddan of the treatments with Hydrogen cyanides and oil natural (garlic and jasmine) was calculated according to Heady and Dillon [21] as follows:

- Total cost of spraying Hydrogen cyanides and oil natural (garlic and jasmine)/Feddan = the price litter × number of trees /feddan × amount of spraying/tree
- Total income = total yield (kg)/feddan × total price
- Net profit (LE) = total income-total cost.

Statistical Analysis: The experimental design used was a complete randomized block design. Difference between treatments was compared by Duncan's Multiple Range Test (Duncan) [22], according to Snedecor and Cochran [23].

RESULTS AND DISCUSSION

Percentage of Bud Burst: Data in Table (3) represents the influence of some breaking dormancy agents on bud burst (%) of the three pomegranate cultivars (H116, Manfalouty and Wonderful). In two spraying dates, observed that, the treatments with dormex at 3%, jasmine oil at 0.3% and dormex at 2% + jasmine at 0.3% gave the highest value of sprouting (%).

Concerning the specific effect of cultivars, each of H116 and Wonderful pomegranate cultivars achieved the highest value during both seasons.

Moreover, there were a significant interaction effect among the breaking dormancy agents, dates and cultivars, spraying cultivar H116 with dormex at 3% in the mid of January attained the higher value than other treatments. While, there were no difference between two sprayed dates in both studied seasons.

The aforementioned results agree with Mahrous and El-Fakhrani [24] and Hegazi [25], they found that application by hydrogen cyanamide (dormex) increased flower and vegetative bud percentage compared with the control. Similar effects were reported by Elmogy *et al.* [26] and Abd El-Wahab *et al.* [27], they found that spraying grapevines with dormex markedly accelerated bud break and eliminated its irregularities to a large extent. Moreover, Sabry *et al.* [28] stated that, the increment of the bud burst (%) by the application of jasmine oil may be due to playing the same role of hydrogen cyanamide.

Table 3: Effect of some breaking dormancy agents on bud burst (%) of some pomegranate cultivars during 2018 and 2019 seasons

Treatments	H 116		Manfalouty		Wonderful		Mean
	15 Jan.	1 Feb.	15 Jan.	1 Feb.	15 Jan.	1 Feb.	
Season 2018							
Control (untreated)	64.50 i-l	64.50 i-l	55.50 vw	55.50 vw	58.50 q-s	58.50 q-s	59.50 E
Dormex at 2%	72.90 d	65.50 h-k	58.90 p-s	57.50 r-u	68.90 ef	63.10 l-n	64.47 B-D
Dormex at 3%	80.00 a	70.00 e	64.00 k-m	60.00 pq	75.00 c	68.00 fg	69.50 A
Jasmine Oil at 0.2%	66.90 gh	64.90 i-l	56.50 t-v	55.50 vw	62.50 mn	60.00 pq	61.05 DE
Jasmine Oil at 0.3%	75.90 c	66.20 hi	60.50 op	58.90 p-s	70.50 e	64.50 i-l	66.08 A-C
Garlic Oil at 2%	64.10 k-m	64.00 i-l	54.90 vw	53.90 w	58.30 q-t	57.90 r-t	59.00 E
Garlic Oil at 3%	64.50 i-l	64.20 j-m	55.00 vw	54.10 w	58.20 q-t	58.00 r-t	59.03 E
Dor. at 2% + Jas. at 0.3%	78.30 b	68.10 c-g	62.50 mn	59.30 p-r	72.90 d	65.00 i-l	67.68 AB
Dor. at 2% + Gar. at 3%	69.20 ef	65.30 h-k	57.30 s-u	56.00 uv	66.10 h-j	62.00 no	62.65 C-E
Mean Cultivars	68.33 A		57.56 B		63.77 AB		
Mean of dates	64.91 A		61.53 A				
Season 2019							
Control (untreated)	61.00 jk	61.00 jk	52.50 u-x	52.50 u-x	56.00 p-r	56.00 p-r	56.50 CD
Dormex at 2%	69.00 d	62.20 h-j	60.00 kl	52.50 u-x	64.00 gh	57.00 n-q	60.78 AB
Dormex at 3%	78.50 a	66.50 e	62.20 h-j	53.30 t-v	68.60 d	57.93 m-o	64.51 A
Jasmine Oil at 0.2%	63.30 g-i	61.90 ij	55.30 q-s	51.90 v-y	61.50 i-k	56.20 o-r	58.35 B- D
Jasmine Oil at 0.3%	73.20 c	62.90 g-i	58.50 l-n	52.60 u-x	63.30 g-i	56.50 o-q	61.17 AB
Garlic Oil at 2%	60.00 kl	59.00 lm	50.20 y	51.00 xy	53.20 t-v	54.00 s-u	54.57 D
Garlic Oil at 3%	61.50 i-k	60.90 jk	52.00 v-y	51.30 w-y	54.60 r-t	55.20 q-s	55.92 D
Dor. at 2% + Jas. at 0.3%	75.00 b	65.68 ef	60.90 jk	53.00 t-w	65.90 e	57.00 n-q	62.91 A
Dor. at 2% + Gar. at 3%	69.00 d	62.40 g-j	57.20 n-p	52.00 v-y	64.10 fg	56.90 n-q	60.27 A-C
Mean Cultivars	65.17 A		54.38 B		58.77 AB		
Mean of dates	61.87 A		57.01 A				

Values having the same letter are not significantly different at 5% level using Duncan's multiple Range Test.

Date of Bud Burst: According to the presented data in Table (4), it could be noticed that, the earliest date of bud burst fulfilled by Dormex at 3% in both studied seasons. With respect to the effect of cultivars, H116 was the earliest one as compared to Manfalouty and Wonderful and the first spraying date was superiority in both seasons. Additionally, the cultivars that sprayed with dormex at 3% and dormex at 2% + jasmine at 0.3% in the first date attained the earliest bud burst date compared with other treatments during 2018 and 2019 seasons. Earliness of budburst with dormex applications may be due to its role in increasing rate of respiration, measured as CO_2 evaluation and by reducing catalase activity as mentioned by Schulman *et al.* [29]. Similarly [30] observed that CH_2N_2 might increase the influx of water into buds and this accumulation of water may assist in advancing the release of bud dormancy. Moreover, [31] and Ben *et al.* [32] have been reported that dormancy in trees is also related to changes in water movement. Furthermore, water dynamics are essential for carbohydrates transport between source and sink during dormancy phase. Many studied suggests that CH_2N_2 application increased the Sorbitol and sucrose concentration in the buds during the endo dormancy

period, which is converted into glucose and fructose for the resumption of growth and flower development and thereby advances bud break [33, 34].

Total Number of Fruits per Tree: Dealing with the specific effect of the three investigated factors (cultivars, spraying date and spraying treatments) and their interaction in Table (5), it could be noticed that, the maximum number of fruits/tree was acquired by dormex at 3% in both seasons of the study. Concerning the effect of cultivars, the Wonderful cv. gave the highest number of fruits/tree. Similarly, the superiority of first sprayed date in the first season while, no difference was observed in the second season. As the effect of interaction among tested factors, it was observed that, Wonderful cv. that sprayed in the mid of January with dormex at 3% recorded the highest number of fruits/tree in both seasons.

Fruit Weight (g): Data in Table (6) show that, the treatments of dormex at 2% and dormex at 3% shared with treatment of dormex at 2% + Jasmine at 0.3% achieved significantly higher average fruit weight than other treatments in both seasons. In addition, the Wonderful cv. was more superior than other two cultivars.

Table 4: Effect of some breaking dormancy agents on date of bud burst of some pomegranate cultivars during 2018 and 2019 seasons

Treatments	H 116		Manfalouty		Wonderful	
	15 Jan.	1 Feb.	15 Jan.	1 Feb.	15 Jan.	1 Feb.
Season 2018						
Control (untreated)	7/2	7/2	17/2	17/2	18/2	18/2
Dormex at 2%	31/1	5/2	15/2	21/2	14/2	17/2
Dormex at 3%	26/1	2/2	14/2	20/2	10/2	15/2
Jasmine Oil at 0.2%	2/2	6/2	17/2	21/2	16/2	18/2
Jasmine Oil at 0.3%	31/1	5/2	17/2	21/2	15/2	18/2
Garlic Oil at 2%	7/2	7/2	17/2	21/2	18/2	18/2
Garlic Oil at 3%	7/2	7/2	17/2	21/2	18/2	18/2
Dor. at 2% + Jas. at 0.3%	29/1	4/2	15/2	21/2	12/2	16/2
Dor. at 2% + Gar. at 3%	1/2	5/2	17/2	21/2	15/2	17/2
Season 2019						
Control (untreated)	9/2	9/2	19/2	19/2	19/2	19/2
Dormex at 2%	1/2	7/2	17/2	18/2	15/2	18/2
Dormex at 3%	27/1	3/2	15/2	18/2	14/2	18/2
Jasmine Oil at 0.2%	3/2	9/2	19/2	19/2	18/2	19/2
Jasmine Oil at 0.3%	1/2	6/2	18/2	19/2	16/2	19/2
Garlic Oil at 2%	9/2	9/2	19/2	19/2	19/2	19/2
Garlic Oil at 3%	9/2	9/2	19/2	19/2	19/2	19/2
Dor. at 2% + Jas. at 0.3%	30/1	7/2	16/2	18/2	14/2	18/2
Dor. at 2% + Gar. at 3%	3/2	7/2	18/2	18/2	15/2	18/2

Table 5: Effect of some breaking dormancy agents on number of fruit/tree of some pomegranate cultivars during 2018 and 2019 seasons

Treatments	H 116		Manfalouty		Wonderful		Mean
	15 Jan.	1 Feb.	15 Jan.	1 Feb.	15 Jan.	1 Feb.	
Season 2018							
Control (untreated)	24.00 o	24.00 o	22.00 q	22.00 q	29.00 j	29.00 j	25.00 E
Dormex at 2%	31.00 h	26.00 m	25.00 n	23.00 p	35.00 d	32.00 g	28.67 C
Dormex at 3%	37.00 c	30.00 i	30.00 i	25.00 n	43.00 a	34.00 e	33.17 A
Jasmine Oil at 0.2%	26.00 m	24.00 o	23.00 p	23.00 p	31.00 h	31.00 h	26.33 DE
Jasmine Oil at 0.3%	29.00 j	25.00 n	26.00 m	24.00 o	32.00 g	32.00 g	28.00 C
Garlic Oil at 2%	23.00 p	22.00 q	22.00 q	20.00 s	26.00 m	27.00 l	23.33 F
Garlic Oil at 3%	25.00 n	23.00 p	23.00 p	21.00 r	30.00 i	29.00 j	25.17 E
Dor. at 2% + Jas. at 0.3%	33.00 f	27.00 l	28.00 k	22.00 q	39.00 b	31.00 h	30.00 B
Dor. at 2% + Gar. at 3%	30.00 i	25.00 n	24.00 o	22.00 q	34.00 e	29.00 j	27.33 CD
Mean Cultivars	26.89 B		23.61 C		31.83 A		
Mean of dates		28.89 A		26.00 B			
Season 2019							
Control (untreated)	40.00 p	40.00 p	34.00 u	34.00 u	44.00 l	44.00 l	39.33 EF
Dormex at 2%	45.00 k	41.00 o	36.00 s	35.00 t	53.00 d	46.00 j	42.67 C
Dormex at 3%	55.00 c	52.00 e	40.00 p	36.00 s	60.00 a	50.00 g	48.83 A
Jasmine Oil at 0.2%	42.00 n	40.00 p	33.00 v	33.00 v	49.00 h	45.00 k	40.33 DE
Jasmine Oil at 0.3%	46.00 j	43.00 m	37.00 r	33.00 v	55.00 c	47.00 i	43.50 C
Garlic Oil at 2%	36.00 s	36.00 s	33.00 v	32.00 w	46.00 j	44.00 l	37.83 F
Garlic Oil at 3%	37.00 r	36.00 s	34.00 u	34.00 u	47.00 i	45.00 k	38.83 EF
Dor. at 2% + Jas. at 0.3%	50.00 g	46.00 j	38.00 q	35.00 t	57.00 b	47.00 i	45.50 B
Dor. at 2% + Gar. at 3%	43.00 m	42.00 n	36.00 s	35.00 t	51.00 f	46.00 j	42.17 CD
Mean Cultivars	42.78 B		34.89 C		48.67 A		
Mean of dates		43.59 A		40.63 A			

Values having the same letter are not significantly different at 5% level using Duncan's multiple Range Test

Table 6: Effect of some breaking dormancy agents on fruit weight (g) of some pomegranate cultivars during 2018 & 2019 seasons

Treatments	H 116		Manfalouty		Wonderful		Mean
	15 Jan.	1 Feb.	15 Jan.	1 Feb.	15 Jan.	1 Feb.	
Season 2018							
Control (untreated)	332.0 y	332.0 y	405.6 no	405.6 no	421.0 ij	421.0 j	386.2 DE
Dormex at 2%	385.2 rs	341.0 w	455.6 e	417.3 jk	472.3 c	417.2 jk	414.8 A
Dormex at 3%	362.4 u	335.0 xy	458.5 e	391.0 q	480.9 b	422.6 i	408.4 AB
Jasmine Oil at 0.2%	365.6 u	334.0 xy	431.9 h	388.7 qr	436.4 g	430.0 h	397.8 C
Jasmine Oil at 0.3%	370.2 t	333.6 xy	415.2 kl	396.9 p	466.4 d	420.8 ij	400.5 BC
Garlic Oil at 2%	357.3 v	330.6 y	411.0 lm	384.2 s	421.4 ij	411.9 l	386.1 DE
Garlic Oil at 3%	337.0 x	331.0 y	397.9 p	363.8 u	433.8 gh	397.0 p	376.6 E
Dor. at 2% + Jas. at 0.3%	390.0 q	344.6 w	441.0 f	407.5 mn	485.2 a	421.8 i	415.0 A
Dor. at 2% + Gar. at 3%	344.6 w	333.3 xy	436.5 g	401.8 o	440.9 f	412.8 l	394.9 CD
Mean Cultivars	347.7 C		411.6 B		434.1 A		
Mean of dates		413.1 A		382.5 B			
Season 2019							
Control (untreated)	320.0 z	320.0 z	398.2 op	398.2 op	413.8 lm	413.8 lm	377.3 C
Dormex at 2%	373.2 s	335.5 v	458.4 d	416.5 kl	470.6 b	425.3 hi	413.3 A
Dormex at 3%	364.0 tu	329.2 wx	450.9 ef	419.3 jk	478.5 a	421.9 ij	410.6 A
Jasmine Oil at 0.2%	360.6 u	325.9 xy	422.9 ig	398.7 op	436.4 g	420.0 jk	394.1 B
Jasmine Oil at 0.3%	365.8 t	331.6 vw	446.4 f	415.9 k -m	455.2 de	423.8 h-j	406.5 A
Garlic Oil at 2%	330.6 v-x	334.6 u	401.4 n-p	389.2 q	411.0 m	411.9 lm	379.8 C
Garlic Oil at 3%	332.8 vw	333.9 vw	403.8 n	397.1 p	397.9 op	399.0 n-p	377.4 C
Dor. at 2% + Jas. at 0.3%	380.4 r	322.0 yz	465.2 c	427.8 h	480.0 a	421.8 ij	416.2 A
Dor. at 2% + Gar. at 3%	376.0 rs	322.3 yz	420.9 i-k	402.8 no	436.5 g	411.8 lm	395.0 B
Mean Cultivars	342.1 B		418.5 A		429.4 A		
Mean of dates		409.3 A		384.1 B			

Values having the same letter are not significantly different at 5% level using Duncan's multiple Range Test

As the effect of spraying date, it was noticed the superiority of the first sprayed date (15 Jan.) in both seasons. Concerning the interaction effect, it could be noticed the superiority of Wonderful cv. that sprayed in 15 Jan. date by each of dormex at 3% and dormex at 2% + jasmine at 0.3% than other treatments in both seasons. The increased of fruit weight (g) in some treatments may be due to the increases of flower in first generation that led's to increase the fruit weight.

These results goes generally with Sabry *et al.* [28] on grape vine, reported that, dormex application caused an obvious increase in berry weight. Moreover, Barakat *et al.* [35]; Zeinab *et al.* [36] and Shereen *et al.* [37], found that, treatment with Jasmine oil concentrations led to improvement the fruit quality.

Total Yield per Tree (kg): Displayed data in Table (7) shows that, the treatment with dormex at (3 %) shared with dormex at (2% + jasmine at 0.3%) have more effective in the yield /tree comparing with other treatments. In addition, the Wonderful cv. achieved the highest yield/tree. Otherwise, there were no appearance differences as the effect of spraying date in both seasons. Regarding to the interaction effect among the treatments

of breaking dormancy agents, dates and cultivars, it could be noticed the superiority of Wonderful cv. that sprayed in the mid of January date with dormex treatment at 3% in each of 2018 and 2019 seasons. The aforementioned results were in agreement with those obtained by Abd El-Wahab *et al.* [27] and Zaghoul *et al.* [10], they reported that spraying trees with jasmine oil increased the number of fruit/tree. Moreover, El-Sabrou *et al.* [7] reported that, spraying with dormex gave the highest yield of grape. In this concern Shereen *et al.* [37] showed that, all sprayed treatments garlic oil, jasmine oil and hydrogen cyanamide alone or in combinations significantly improved fruit quality and yield of Fig.

Date of Commencement of Harvest: Record data in Table (8) demonstrated that, treatments with dormex at 3% and dormex at 2% + jasmine at 0.3% achieved the earliest harvest date compared with other treatments. As the effect of cultivar, the earliest date of harvesting fulfilled by H116 and Wonderful cvs. Concerning the interaction effect, it could be noticed the superiority of H116 and Wonderful cvs. that sprayed with dormex at 3% and dormex at 2% + jasmine at 0.3% in the mid of January. These results are in line with findings of Hegazi *et al.* [38]

Table 7: Effect of some breaking dormancy agents on yield (Kg/tree) of some pomegranate cultivars during 2018 & 2019 seasons

Treatments	H 116		Manfalouty		Wonderful		Mean
	15 Jan.	1 Feb.	15 Jan.	1 Feb.	15 Jan.	1 Feb.	
Season 2018							
Control (untreated)	7.97 x-z	7.97 x-z	8.92 s-x	8.92 s-x	12.21 g-i	12.21 g-i	9.70 CD
Dormex at 2%	11.94 h-j	8.87 t-x	11.39 i-l	9.60 q-t	16.53 c	13.33 ef	11.94A-C
Dormex at 3%	13.41 ef	10.05 n-r	13.76 ef	9.78 p-t	20.68 a	14.04 e	13.62 A
Jasmine Oil at 0.2%	9.51 q-t	8.02 w-z	9.93 o-s	8.94 s-x	13.53 ef	13.33 ef	10.54 B-D
Jasmine Oil at 0.3%	10.74 k-p	8.34 u-y	10.82 k-o	9.53 q-t	14.92 d	13.47 ef	11.30 B-D
Garlic Oil at 2%	8.22 v-z	7.27 z	9.04 r-w	7.68 yz	10.96 k-n	11.12 j-m	9.04 D
Garlic Oil at 3%	8.43 u-y	7.61 yz	9.15 r-v	7.64 yz	13.01 fg	11.51 i-k	9.55 CD
Dor. at 2% + Jas. at 0.3%	12.87 f-h	9.30 r-u	12.35 g-i	8.97 s-x	18.92 b	13.08 e-g	12.58 AB
Dor. at 2% + Gar. at 3%	10.34 m-q	8.33 u-y	10.48 l-q	8.84 t-x	14.99 d	11.97 h-j	10.83 B-D
Mean Cultivars	9.40 B		9.76 B		13.88 A		
Mean of dates		12.04 A		9.99 A			
Season 2019							
Control (untreated)	12.80 u-w	12.80 u-w	13.54 q-u	13.54 q-u	18.21 ij	18.21 ij	14.85 E
Dormex at 2%	16.79 lm	13.76 q-t	16.50 lm	14.58 n-p	24.94 c	19.56 fg	17.69 BC
Dormex at 3%	20.02 f	17.12 kl	18.04 ij	15.09 n	28.71 a	21.10 e	20.01 A
Jasmine Oil at 0.2%	15.15 n	13.04 t-v	13.96 p-s	13.16 t-v	21.38 e	18.90 gh	15.93 DE
Jasmine Oil at 0.3%	16.83 lm	14.26 o-q	16.52 lm	13.72 q-t	25.04 c	19.92 f	17.72 BC
Garlic Oil at 2%	11.90 x	13.05 t-v	13.25 s-u	12.45 v-x	18.91 gh	18.12 ij	14.61 E
Garlic Oil at 3%	12.31 wx	12.02 x	13.73 q-t	13.50 r-u	18.70 hi	17.96 j	14.70 E
Dor. at 2% + Jas. at 0.3%	19.02 gh	14.81 no	17.68 jk	14.97 n	27.36 b	19.82 f	18.94 AB
Dor. at 2% + Gar. at 3%	16.17 m	13.54 q-u	15.15 n	14.10 p-r	22.26 d	18.94 gh	16.69 CD
Mean Cultivars	14.74 B		14.64 B		21.00 A		
Mean of dates		17.96 A		15.63 A			

Values having the same letter are not significantly different at 5% level using Duncan's multiple Range Test.

Table 8: Effect of some breaking dormancy agents on date of commencement of harvest (number of days) of some pomegranate cultivars during 2018 & 2019 seasons

Treatments	H 116		Manfalouty		Wonderful	
	15 Jan.	1 Feb.	15 Jan.	1 Feb.	15 Jan.	1 Feb.
Season 2018						
Control (untreated)	81	81	125	125	127	127
Dormex at 2%	75	80	124	125	122	127
Dormex at 3%	70	76	120	125	119	127
Jasmine Oil at 0.2%	78	81	125	125	125	127
Jasmine Oil at 0.3%	76	80	125	125	122	127
Garlic Oil at 2%	81	81	125	125	127	127
Garlic Oil at 3%	81	81	125	125	127	127
Dor. at 2% + Jas. at 0.3%	71	78	125	125	122	127
Dor. at 2% + Gar. at 3%	75	80	125	125	123	127
Season 2019						
Control (untreated)	84	84	130	130	130	130
Dormex at 2%	79	84	130	130	124	130
Dormex at 3%	74	80	130	130	120	130
Jasmine Oil at 0.2%	80	84	130	130	125	130
Jasmine Oil at 0.3%	76	82	130	130	122	130
Garlic Oil at 2%	84	84	130	130	130	130
Garlic Oil at 3%	84	84	130	130	130	130
Dor. at 2% + Jas. at 0.3%	74	84	130	130	120	130
Dor. at 2% + Gar. at 3%	80	84	130	130	125	130

on Thompson seedless grapevines and each of Mahrous and El-Fakharani [24] on apricot, found that dormancy breaking agents enhanced harvest time compared to the control.

Fruit Length (cm): Concerning the fruit length that presented in Table (9) it could be noticed that, there were no differences among the spraying treatments in both studied seasons except garlic oil in the second one. Average fruit length was significantly highest in Wonderful cv. compared to both cultivars in both seasons of the study. Similarly, there were no difference between two spraying date in both seasons. As the effect of interaction, each of treatment with dormex at (2 & 3%) and dormex at 2% + jasmine oil at 0.3% on Wonderful cv. at mid of January increased fruit length compared with other treatments.

Fruit Width (cm): Data presented in Table (10) demonstrated that, no difference between spraying treatments in the first season while, dormex treatment at (2 & 3%) and dormex at 2% + jasmine oil at 0.3% resulted in the highest significant fruit width (cm) in the second

season of the study. Moreover, no difference between spraying dates was observed on fruit width in both seasons. These results were in a parallel with cultivars except H116 cv. in second seasons. Dealing with the interaction among treatments of breaking dormancy agents, dates and cultivars, it was differ from first season and second seasons.

Total Soluble Solids (TSS %): As regard to the trend of spraying treatments, dates and cultivars on the total soluble solids (TSS %) that presented in Table (11) it could be noticed that, they did not recorded any significant difference among them in the first and second studied seasons. According to the interaction effect, it was differ from season to another.

Total Acidity (%): It is quite clear from the tabulated data in Table (12) that, there were no statically difference among the tested treatment of breaking dormancy agents, dates and cultivars in the total acidity (%) in both studied seasons. As regard to the interaction effect, it was differ from first and second seasons of the study.

Table 9: Effect of some breaking dormancy agents on fruit length (cm) of some pomegranate cultivars during 2018 & 2019 seasons

Treatments	H 116		Manfalouty		Wonderful		Mean
	15 Jan.	1 Feb.	15 Jan.	1 Feb.	15 Jan.	1 Feb.	
Season 2018							
Control (untreated)	8.16 qr	8.16 qr	8.63 h-l	8.63 h-l	8.43 l-o	8.43 l-o	8.41 A
Dormex at 2%	8.23 o-q	7.86 s	9.16 ab	8.86 d-g	9.03 a-d	8.83 d-h	8.66 A
Dormex at 3%	8.26 o-q	7.83 s	9.13 a-c	8.86 d-g	9.16 ab	8.80 e-h	8.67 A
Jasmine Oil at 0.2%	8.16 qr	7.33 v	8.70 g-k	8.43 l-o	8.80 e-h	8.20 p-r	8.27 A
Jasmine Oil at 0.3%	8.43 l-o	8.23 o-q	8.76 f-i	8.53 j-m	9.00 b-e	8.53 j-m	8.58 A
Garlic Oil at 2%	8.10 qr	7.53 tu	8.76 f-i	8.10 qr	8.53 j-m	8.00 rs	8.17 A
Garlic Oil at 3%	8.13 qr	7.40 uv	8.56 i-m	8.20 p-r	8.73 f-j	8.30 n-q	8.22 A
Dor. at 2% + Jas. at 0.3%	8.66 g-k	8.23 o-q	9.23 a	8.63 h-l	9.16 ab	8.76 f-i	8.78 A
Dor. at 2% + Gar. at 3%	8.20 p-r	7.63 t	8.63 h-l	8.23 o-q	8.93 c-f	8.40 m-p	8.34 A
Mean Cultivars	8.03 A		8.62 A		8.65 A		
Mean of dates	8.65 A		8.26 A				
Season 2019							
Control (untreated)	8.00 t-v	8.00 t-v	8.35 l-o	8.35 l-o	8.45 i-l	8.45 i-l	8.26 B
Dormex at 2%	8.25 o-q	8.11 e-t	8.95 de	8.65 fg	9.18 a	8.65 fg	8.63 A
Dormex at 3%	8.29 n-p	8.13 q-s	8.90 e	8.50 h-k	9.13 ab	8.60 f-h	8.59 A
Jasmine Oil at 0.2%	8.15 q-s	8.00 t-v	8.60 f-h	8.35 l-o	8.95 de	8.49 h-k	8.42 AB
Jasmine Oil at 0.3%	8.32 m-o	8.10 r-t	8.70 f	8.40 j-n	9.05 b-d	8.52 h-j	8.51 AB
Garlic Oil at 2%	8.05 s-u	7.85 w	8.50 h-k	8.20 p-r	8.50 h-k	8.40 j-n	8.25 B
Garlic Oil at 3%	8.07 st	7.90 vw	8.40 j-n	8.25 o-q	8.55 g-i	8.42 j-m	8.26 B
Dor. at 2% + Jas. at 0.3%	8.40 j-n	8.16 q-s	9.00 c-e	8.45 i-l	9.10 a-c	8.58 f-h	8.61 A
Dor. at 2% + Gar. at 3%	8.12 r-t	7.94 u-w	8.70 f	8.38 k-n	9.00 c-e	8.50 h-k	8.44 AB
Mean Cultivars	8.10 B		8.55 AB		8.69 A		
Mean of dates	8.58 A		8.30 A				

Values having the same letter are not significantly different at 5% level using Duncan's multiple Range Test.

Table 10: Effect of some breaking dormancy agents on fruit width (cm) of some pomegranate cultivars during 2018 & 2019 seasons

Treatments	H 116		Manfalouty		Wonderful		Mean
	15 Jan.	1 Feb.	15 Jan.	1 Feb.	15 Jan.	1 Feb.	
Season 2018							
Control (untreated)	8.93 e-i	8.93 e-i	9.46 l-m	9.46 l-m	9.63 i-l	9.63 i-l	9.34 A
Dormex at 2%	9.76 f-k	9.56 k-m	10.67 a	10.33 b	10.10 cd	9.83 e-i	10.04 A
Dormex at 3%	9.80 e-j	9.13 p	10.57 a	9.96 c-f	10.33 b	9.33 no	9.85 A
Jasmine Oil at 0.2%	9.60 j-l	9.30 n-p	10.13 c	9.70 g-k	9.96 c-f	9.36 no	9.68 A
Jasmine Oil at 0.3%	9.63 i-l	9.70 g-k	10.17 bc	9.76 f-k	10.10 cd	9.90 d-g	9.88 A
Garlic Oil at 2%	9.66 h-l	8.80 q	9.80 e-j	9.26 n-p	9.76 f-k	9.63 i-l	9.49 A
Garlic Oil at 3%	9.23 op	8.63 q	9.76 f-k	9.23 op	9.70 g-k	9.63 q	9.36A
Dor. at 2% + Jas. at 0.3%	9.96 c-f	9.56 k-m	10.10 cd	9.86 e-h	10.63 a	9.83 e-i	9.99 A
Dor. at 2% + Gar. at 3%	9.76 f-k	8.63 q	10.00 c-e	9.83 e-i	10.33 b	9.40 m-o	9.66 A
Mean Cultivars	9.37 A		9.89 A		9.84 A		
Mean of dates		9.91 A		9.50 A			
Season 2019							
Control (untreated)	8.74 z	8.74 z	9.30 s-v	9.30 s-v	9.42 n-q	9.42 n-q	9.15 F
Dormex at 2%	9.40 o-r	8.90 x	10.00 c	9.75 gh	10.16 b	9.66 ij	9.64 AB
Dormex at 3%	9.43 n-q	8.85 xy	9.96 cd	9.60 jk	10.00 c	9.59 jk	9.57 A-C
Jasmine Oil at 0.2%	9.25 uv	8.81 yz	9.72 hi	9.38 p-s	9.52 k-m	9.45 m-p	9.35 DE
Jasmine Oil at 0.3%	9.32 r-u	8.85 xy	9.89 de	9.50 l-n	9.93 cd	9.56 kl	9.50 B-D
Garlic Oil at 2%	8.85 xy	8.75 z	9.42 n-q	9.25 uv	9.30 s-v	9.22 v	9.13 F
Garlic Oil at 3%	8.93 wx	8.80 yz	9.47 m-o	9.29 t-v	9.33 r-u	9.30 s-v	9.18 EF
Dor. at 2% + Jas. at 0.3%	9.35 q-t	9.00 w	10.20 b	9.80 fg	10.37 a	9.70 hi	9.73 A
Dor. at 2% + Gar. at 3%	9.27 t-v	8.90 x	9.65 ij	9.50 l-n	9.84 ef	9.50 l-n	9.44 CD
Mean Cultivars	9.00 B		9.61 A		9.62 A		
Mean of dates		9.55 A		9.27 A			

Values having the same letter are not significantly different at 5% level using Duncan's multiple Range Test.

Table 11: Effect of some breaking dormancy agents on total soluble solids (%) of some pomegranate cultivars during 2018 & 2019 seasons

Treatments	H 116		Manfalouty		Wonderful		Mean
	15 Jan.	1 Feb.	15 Jan.	1 Feb.	15 Jan.	1 Feb.	
Season 2018							
Control (untreated)	13.0 n	13.0 n	15.0 i-k	15.0 i-k	16.0 f-h	16.0 f-h	14.67 A
Dormex at 2%	15.0 i-k	14.0 lm	16.5 d-f	15.20 h-k	18.0 ab	17.0 c-e	15.95 A
Dormex at 3%	14.0 lm	13.5 mn	16.0 f-h	14.6 j-l	17.5 bc	16.6 d-f	15.37 A
Jasmine Oil at 0.2%	13.5 mn	13.0 n	15.5 g-j	15.0 i-k	17.2 b-d	16.2 e-g	15.07 A
Jasmine Oil at 0.3%	13.5 mn	13.20 mn	15.80 f-i	15.2 h-k	17.3 b-d	16.5 d-f	15.25 A
Garlic Oil at 2%	13.2 mn	13.0 n	15.00 i-k	15.0 i-k	16.5 d-f	16.0 f-h	14.78 A
Garlic Oil at 3%	13.3 mn	13.3 mn	15.00 i-k	15.0 i-k	16.9 c-e	16.2 e-g	14.90 A
Dor. at 2% + Jas. at 0.3%	15.5 g-j	14.5 kl	16.6 c-f	15.5 g-j	18.5 a	17.2 b-d	16.31 A
Dor. at 2% + Gar. at 3%	13.5 mn	13.0 n	16.0 f-h	15.2 h-k	17.0 c-e	16.6 d-f	15.22 A
Mean Cultivars	13.59 A		15.40 A		16.84 A		
Mean of dates		15.59 A		14.97 A			
Season 2019							
Control (untreated)	13.3 l-n	13.3 l-n	15.0 g-i	15.0 g-i	15.6 e-g	15.6 e-g	14.63 A
Dormex at 2%	14.5 h-j	14.0 j-l	17.0 ab	15.5 e-g	16.8 a-c	16.0 d-f	15.63 A
Dormex at 3%	14.0 j-l	13.5 k-m	16.0 d-f	15.3 e-h	16.0 d-f	15.6 e-g	15.07 A
Jasmine Oil at 0.2%	13.8 j-m	13.4 k-m	15.5 e-g	15.0 g-i	16.1 c-e	15.5 e-g	14.88 A
Jasmine Oil at 0.3%	14.0 j-l	13.6 k-m	16.0 d-f	15.2 f-h	16.5 b-d	15.5 e-g	15.13 A
Garlic Oil at 2%	13.0 mn	12.6 n	15.2 f-h	15.0 g-i	15.0 g-i	15.0 g-i	14.55 A
Garlic Oil at 3%	13.1 mn	13.0 mn	15.5 e-g	15.0 g-i	15.0 g-i	15.0 g-i	14.43 A
Dor. at 2% + Jas. at 0.3%	15.0 g-i	14.2 i-k	17.5 a	15.5 e-g	15.50 e-g	16.0 d-f	15.62 A
Dor. at 2% + Gar. at 3%	13.5 k-m	13.7 k-m	16.0 d-f	15.0 g-i	15.9 d-f	15.0 g-i	14.85 A
Mean Cultivars	13.64 A		15.57 A		15.73 A		
Mean of dates		15.25 A		14.70 A			

Values having the same letter are not significantly different at 5% level using Duncan's multiple Range Test.

Table 12: Effect of some breaking dormancy agents on total acidity (%) of some pomegranate cultivars during 2018 & 2019 seasons

Treatments	H 116		Manfalouty		Wonderful		Mean
	15 Jan.	1 Feb.	15 Jan.	1 Feb.	15 Jan.	1 Feb.	
Season 2018							
Control (untreated)	1.62 a	1.62 a	1.31 c-h	1.31 c-h	1.24 e-l	1.24 e-l	1.39 A
Dormex at 2%	1.41 bc	1.50 ab	1.15 j-n	1.29 c-i	1.13 k-n	1.22 e-m	1.28 A
Dormex at 3%	1.33 c-f	1.56 a	1.25 e-l	1.27 d-j	1.07 n	1.20 f-m	1.28 A
Jasmine Oil at 0.2%	1.40 b-d	1.51 ab	1.18 h-n	1.30 c-i	1.19 g-n	1.24 e-l	1.30 A
Jasmine Oil at 0.3%	1.35 c-e	1.51 ab	1.30 c-i	1.28 c-j	1.17 i-n	1.23 e-m	1.31 A
Garlic Oil at 2%	1.56 a	1.58 a	1.29 c-i	1.32 c-g	1.23 e-m	1.25 e-l	1.37 A
Garlic Oil at 3%	1.35 c-e	1.50 ab	1.18 h-n	1.30 c-i	1.23 e-m	1.24 e-l	1.30A
Dor. at 2% + Jas. at 0.3%	1.40 b-d	1.55 a	1.20 f-m	1.26 e-k	1.10 mn	1.20 f-m	1.29 A
Dor. at 2% + Gar. at 3%	1.60 a	1.31 c-h	1.31 c-h	1.31 c-h	1.12 l-n	1.23 e-m	1.31 A
Mean Cultivars	1.48 A		1.26 A		1.19 A		
Mean of dates		1.28 A		1.34 A			
Season 2019							
Control (untreated)	1.65 a	1.65 a	1.36 f	1.36 f	1.28 f-j	1.28 f-j	1.43 A
Dormex at 2%	1.50 c-e	1.64 ab	1.27 f-k	1.35 f	1.13 mn	1.26 f-k	1.35 A
Dormex at 3%	1.48 de	1.60 a-c	1.23 h-m	1.33 f-h	1.17 k-n	1.24 g-l	1.34 A
Jasmine Oil at 0.2%	1.57 a-d	1.65 a	1.30 f-i	1.36 f	1.20 i-n	1.25 f-k	1.38 A
Jasmine Oil at 0.3%	1.51 c-e	1.64 ab	1.25 f-k	1.35 f	1.14 l-n	1.23 h-m	1.35 A
Garlic Oil at 2%	1.60 a-c	1.67 a	1.32 f-h	1.36 f	1.26 f-k	1.27 f-k	1.41 A
Garlic Oil at 3%	1.59 a-c	1.66 a	1.31 f-h	1.36 f	1.25 f-k	1.26 f-k	1.40 A
Dor. at 2% + Jas. at 0.3%	1.46 e	1.59 a-c	1.24 g-l	1.32 f-h	1.10 n	1.23 h-m	1.32 A
Dor. at 2% + Gar. at 3%	1.54 b-e	1.63 ab	1.30 f-i	1.34 fg	1.19 j-n	1.26 f-k	1.37 A
Mean Cultivars	1.59 A		1.31 A		1.22 A		
Mean of dates		1.31 A		1.41 A			

Values having the same letter are not significantly different at 5% level using Duncan's multiple Range Test

Table 13: Effect of some breaking dormancy agents on anthocyanin (%) of some pomegranate cultivars during 2018 & 2019 seasons

Treatments	H 116		Manfalouty		Wonderful		Mean
	15 Jan.	1 Feb.	15 Jan.	1 Feb.	15 Jan.	1 Feb.	
Season 2018							
Control (untreated)	0.373 c-e	0.373 c-e	0.312 jk	0.312 jk	0.334 gh	0.334 gh	0.339 A
Dormex at 2%	0.395 a	0.379 c-e	0.330 g-i	0.315 jk	0.365 e	0.338 fg	0.353 A
Dormex at 3%	0.400 a	0.375 c-e	0.335 g	0.317 i-k	0.370 de	0.336 g	0.355 A
Jasmine Oil at 0.2%	0.380 cd	0.370 de	0.320 h-k	0.313 jk	0.350 f	0.334 gh	0.344 A
Jasmine Oil at 0.3%	0.396 ab	0.380 cd	0.336 g	0.319 i-k	0.366 de	0.336 g	0.355 A
Garlic Oil at 2%	0.372 c-e	0.370 de	0.310 k	0.312 jk	0.325 g-j	0.320 h-k	0.334 A
Garlic Oil at 3%	0.370 de	0.371 de	0.315 jk	0.310 k	0.330 g-i	0.325 g-j	0.336 A
Dor. at 2% + Jas. at 0.3%	0.405 a	0.380 cd	0.335 g	0.320 h-k	0.375 c-e	0.335 g	0.358 A
Dor. at 2% + Gar. at 3%	0.386 bc	0.374 c-e	0.324 g-k	0.313 jk	0.350 f	0.335 g	0.347 A
Mean Cultivars	0.380 A		0.319 B		0.342 AB		
Mean of dates		0.354 A		0.340 A			
Season 2019							
Control (untreated)	0.353 d-h	0.353 d-h	0.312 s-u	0.312 s-u	0.334 j-o	0.334 j-o	0.333 A
Dormex at 2%	0.370 a-c	0.358 c-f	0.335 j-n	0.319 p-t	0.360 c-e	0.340 h-l	0.347 A
Dormex at 3%	0.375 ab	0.360 c-e	0.332 j-p	0.320 o-t	0.355 d-g	0.342 g-k	0.347 A
Jasmine Oil at 0.2%	0.360 c-e	0.355 d-g	0.325 m-s	0.317 q-t	0.350 e-i	0.334 j-o	0.340 A
Jasmine Oil at 0.3%	0.366 b-d	0.358 c-f	0.336 i-n	0.320 o-t	0.357 c-f	0.339 h-m	0.346 A
Garlic Oil at 2%	0.335 j-n	0.340 h-l	0.310 tu	0.300 u	0.330 j-q	0.325 m-s	0.323 A
Garlic Oil at 3%	0.350 e-i	0.344 f-j	0.315 r-t	0.310 tu	0.335 j-n	0.327 l-r	0.330 A
Dor. at 2% + Jas. at 0.3%	0.380 a	0.360 c-e	0.340 h-l	0.323 n-t	0.366 b-d	0.340 h-l	0.351 A
Dor. at 2% + Gar. at 3%	0.360 c-e	0.350 e-i	0.329 k-r	0.316 q-t	0.353 d-h	0.335 j-n	0.340 A
Mean Cultivars	0.357 A		0.320 A		0.342 A		
Mean of dates		0.345A		0.334 A			

Values having the same letter are not significantly different at 5% level using Duncan's multiple Range Test.

Table 14: Economic evaluation of breaking dormancy agents during 2019 season

Treatments	Cost of materials	Cost of spraying process/ fed. (LE)	Total cost (LE)	Yield kg/tree	Yield ton/fed.	Total income/ fed. (LE)	Net profit (LE)
Control (untreated)	---	---	---	14.85	4.16	8316	8316
Dormex at 2%	770	100	780	17.69	4.95	9906	9126
Dormex at 3%	1176	100	1276	20.01	5.60	11206	9930
Jasmine Oil at 0.2%	200	100	300	15.93	4.46	8921	8621
Jasmine Oil at 0.3%	300	100	400	17.72	4.96	9923	9523
Garlic Oil at 2%	270	100	370	14.61	4.09	8182	7812
Garlic Oil at 3%	400	100	500	14.70	4.12	8232	7732
Dor. at 2% + Jas. at 0.3%	1070	100	1170	18.94	5.30	10606	9436
Dor. at 2% + Gar. at 3%	1170	100	1270	16.69	4.67	9346	8076

Total Anthocyanin Content (%): Data in Table (13) illustrated that, there were no difference among the spraying treatments and that were agree with the spraying dates in both seasons. As regard to the effect of cultivar, the H116 cultivar exhibited the maximum anthocyanin content in juice in first seasons comparing to other cultivars, otherwise, there were no differences among them in the second season. Similarly, there were a significant interaction effect among the treatments of breaking dormancy agents, dates and cultivars, concomitant to H116 cultivar that sprayed with dormex treatment at (2 & 3%) and dormex at 2% + jasmine oil at 0.3% in the mid of January .

The present result goes partially in the line with that pointed out by Abo-El-Ez *et al.* [39] who found that, an increase in total soluble solids percentage and anthocyanin content in fruit juice due to the application of hydrogen cyanamide. Moreover, Feng *et al.* [11] reported that, the essential oils may slow some vital processes, while enhance juvenility, lowering consumption of sugars by hindering ethylene action and retarding the quick senescence of plant organs and in turn utilization of sugars that finally improved fruit quality.

Economic Evaluation: Data presented in Table (14) indicate that, the treatments with hydrogen cyanamide (dormex) and jasmine oil alone or combined together gave better net profit than the control. The maximum total income /fed recorded by the treatments of hydrogen cyanamide at 3%, followed by treatment with jasmine oil at 0.3%.

CONCLUSION

It could be concluded from the present study, that treatments with dormex and jasmine oil alone or combinations were effective in early bud burst and harvest under warm winter. In addition, the treatment with dormex at 3% was more effecting than the other treatments and leading to achieve higher profitability. In addition, H 116 cultivar was earliest cultivar in opening

the bud and harvest. While, Wonderful cultivar gave the highest value in number of fruits, fruit weight, fruit yield, fruit length and fruit width (cm).

Thus, it can be recommended that, treatment with hydrogen cyanamide alone or combination with jasmine oil on 15th January could be a suitable of pomegranate fruits under Giza governorate climatic conditions.

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