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Effects of Some Dormancy Breaking Agents on Flowering, Fruiting and Fruit Characteristics of 'Canino' Apricot Cultivar

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Abstract: This study was carried out during two successive seasons (2009 and 2010) on nine year old Canino apricot trees (*Prunus armeniaca* L.) budded on Nemaguard peach rootstock growing in sandy soil at a private orchard, Noubaria, Behira Governorate, Egypt. The aim of this investigation is to study the effect of the following treatments: Urea at 5, 10 and 15%, zinc sulphate at 5, 10 and 15%, hydrogen cyanamide (H_2CN_2 49%) at 1, 2 and 3% and control (sprayed with water), sprayed at four weeks before full bloom on flowering and harvesting time, flower and vegetative bud percentage, initial and final fruit set and fruit characteristics (fruit length, diameter, weight, volume, length/diameter ratio, seed weight, total soluble solids, firmness and fresh weight). From the obtained results, it was noticed that flowering and harvesting time were enhanced and earlier by treatments, flower and vegetative bud percentage were increased also initial and final fruit set were improved. Also, fruit characteristics were improved by spraying these chemicals while hydrogen cyanamide at 1, 2, 3% and zinc sulphate 10 and 15% were more effective than urea and control treatments.

Key words: Apricot · Canino cultivar · Urea · Zinc sulphate · Hydrogen cyanamide · Flower buds · Vegetative buds · Fruit set · Fruit characteristics

INTRODUCTION

Overcoming dormancy represents one of the major limitations for fruit trees production in the warm areas. Inadequate chilling in warm winter periods causes poor bud break and fruit set in apricot and plum because of their high chilling requirements and these crops are in high demand in this area for both local consumption and export, therefore the use dormancy breaking agents is essential. The use of hydrogen cyanamide (dormex) is money consuming therefore it is very important to replace dormex with more cheaper and effective one to get good bud break and fruit set. The hydrogen cyanamide application in apricot and plums caused uniform bud break [1]. Moreover, the response of the tree to chemicals that break dormancy may vary according to chilling accumulation, application time, concentration and environmental factors [2].In subtropical conditions, apricot and plum trees flowering are delayed and fruit set is poor, thus several chemicals were used in different countries to break dormancy where the chilling hours were insufficient. The amount of cold and heat required for the buds to break dormancy are different from flower buds to vegetative buds Guerriero *et al.* [3], stated that, flower buds have greater cold requirements than vegetative buds. The latter, however, need more heat than the former for termination of the dormant period. Chilling accumulation in the coastal Mediterranean regions changed from year to year and insufficient chilling caused less flowering and fruit set in peach and nectarine cultivars which required high chilling [4].

The purpose of this study was to investigate the effect of urea, zinc sulphate and hydrogen cyanamide at different concentrations on flowering time, vegetative and flowering bud percentage, fruit set and fruit characteristic of Canino apricot cv. under Egyptian desert conditions. Also, to determine the effective compounds, concentrations and time of application that more effective in improving flowering, fruiting and fruit quality.

MATERIALS AND METHODS

The present study was carried out during 2009 and 2010 seasons on Canino apricot cv. (*Prunus armeniaca* L.), uniform, 9 years old growing in sandy soil at a private farm located at El Bostan, Noubaria, El-Behira Governorate, Egypt, planted at distance 6 x 6 meters and subjected to the same agriculture practices. Trees under this study were subjected to the following treatments:

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- Urea 5%
- Urea 10%
- Urea 15%
- Zinc sulphate 5%
- Zinc sulphate 10%
- Zinc sulphate 15%
- Hydrogen cyanamide (H_2CN_2 49%) 1% (Dormex)
- Hydrogen caynamide (H_2CN_2 49%) 2%
- Hydrogen cyanamide (H_2CN_2 49%)3%
- Control (sprayed with water).

Trees were trained to a vase shape. Thirty trees were selected (3 trees per each treatment). In both seasons treatments were applied at 4 weeks before full bloom (22 January) when the buds were still dormant. All the trees were sprayed. Ten shoots were tagged randomly from each tree to observe and measure the following parameters:

- Date of full bloom (60% of flower opening).
- Date of harvest time at the stage of changing of the base colour of the fruits from green to yellow.
- Number of buds that burst/meter was calculated to determine flower and vegetative buds %.
- Initial fruit set was estimated at 21 days after full bloom as average number of fruits/meter. Final fruit set was estimated at 45 days after full bloom as average number of fruits / meter.

Fruit Characteristics: Samples of 10 fruits from each replicate tree (30 fruits for each treatment) were collected randomly at harvest time and the following characteristics were recorded.

- Average fruit length (cm).
- Average fruit diameter (cm).
- Average fruit weight (g).
- Average fruit volume (cm^3).
- Fruit shape index (fruit length / fruit diameter ratio).
- Average seed weight (g).
- Average total soluble solids (TSS %): Total soluble solids in juice were measured using Abb. Refractometer (Bausch and Lomb. Japan).
- Average fruit firmness (1b/$inch^2$) by using V.C. firmness tester (A. Metek. Testing Equipment system, U.S.A) which was equipped with plunger 5/16 inches.
- Average flesh weight (g).

Experimental Design and Data Analysis: The layout of the experiment was randomized complete blocks design that each treatment consists of 3 replicates (one tree per replicate). The obtained data were subjected to analysis of variance (ANOVA) according to Snedecor and Cochran [5]. Mstat-c program [6] was used to calculate the least significant differences LSD to compare between means of treatments according to Walter and Duncan [7] at probability of 0.05.

RESULTS AND DISCUSSION

Effect of Spraying Some Dormancy Breaking Agents on Julian Dates of Full Bloom and Harvest Time of Canion cv: In the first season, it was noticed that Julian dates for full bloom and harvest time were significantly late (90.33 and 149.00 days) in comparison with control treatment and other treatments (Table 1), while the earliest dates for full bloom and harvest time were observed in hydrogen caynamide treatment at 3% with average (61.00 and 133.00 days). In the second season, similar trend was observed (Table 1). These results are in line with findings of Smith [8] on deciduous fruit trees, Hegazi *et al*. [9] on Thompson seedless grapevines, Son [10] on Tokaloglu and Karacabey apricot cvs. and Mahrous and El-Fakhrani [11] on Amar apricot cv. who found that dormancy breaking agents enhanced flowering and harvest time compared to the control.

Effect of Spraying Some Dormancy Breaking Agents on Flower Bud and Vegetative Bud Percentage of Canino Apricot cv: In the first season, it was obvious that flower bud % was significantly higher (54.17%) with Zinc sulphate treatment at 15% compared with the other treatments, while, it was the lowest (12.17%) with control treatment (Table 2). Vegetative bud % recorded the highest value (29.67%) with dormex treatment at 3% compared with the other treatments, while, it was the lowest (18.33%) with control treatment. This trend was also noticed in the second season (Table 2). These findings are in line with results of Son [10] on Tokaloglue and Karacabey apricot cvs. Who found that (hydrogen cyanmide 49%) with concentrations 1 and 2% caused better flower and vegetative bud break ratio. Also, findings by Mahrous and El-Fakhrani [11] that application of dormex 1%, zinc sulphate 5% and Urea 5% increased vegetative and flower bud break ratio compared with the control treatment.

Table 1: Effect of some dormancy breaking agents on Julian date of full bloom and harvest time of Canino apricot cv. in seasons 2009 and 2010.

	2009		2010	
Treatments	*FB	Harvest	*FB	Harvest
Urea 5%	80.67	140.70	79.00	142.00
Urea 10%	77.67	139.30	74.67	137.30
Urea 15%	74.33	137.70	72.67	137.00
Zinc sulphate 5%	79.00	140.00	78.00	143.70
Zinc sulphate 10%	72.33	144.00	72.33	142.30
Zinc sulphate 15%	70.00	142.00	68.67	141.30
Hydrogen cyanamide 1%	67.00	141.00	65.33	138.70
Hydrogen cyanamide 2%	64.00	137.30	64.67	135.30
Hydrogen cyanamide 3%	61.00	133.00	62.33	134.70
Control (Water only)	90.33	149.00	89.00	150.00
LSD 5%	0.822	0.891	1.029	0.618

* FB= Full bloom

Table 2: Effect of some dormancy breaking agents on flower and vegetative bud percentage of Canino apricot cv. in seasons 2009 and 2010.

	2009		2010	
Treatments	Flower bud %	Vegetative bud %	Flower bud %	Vegetative bud %
Urea 5%	35.60	21.33	34.00	21.67
Urea 10%	42.37	22.33	42.00	22.33
Urea 15%	42.03	23.33	41.33	24.00
Zinc sulphate 5%	36.43	24.00	36.53	24.67
Zinc sulphate 10%	50.33	24.33	51.33	24.23
Zinc sulphate 15%	54.17	25.33	52.80	25.67
Hydrogen cyanamide 1%	31.69	25.67	31.93	26.33
Hydrogen cyanamide 2%	44.67	27.00	44.30	27.00
Hydrogen cyanamide 3%	48.33	29.67	48.63	29.67
Control (Water only)	12.17	18.33	11.57	18.00
LSD 5%	2.729	1.075	2.839	1.043

Table 3: Effect of dormancy breaking agents on initial and final fruit set of Canino apricot cv. in seasons 2009 and 2010

	2009		2010	
Treatments	Initial	Final	Initial	Final
Urea 5%	11.54	9.33	11.33	9.23
Urea 10%	13.50	11.43	13.83	11.67
Urea 15%	13.09	10.77	13.50	11.70
Zinc sulphate 5%	16.01	13.17	15.67	13.33
Zinc sulphate 10%	19.67	17.33	20.33	17.20
Zinc sulphate 15%	18.98	17.00	19.67	17.30
Hydrogen cyanamide 1%	23.76	21.33	23.67	21.17
Hydrogen cyanamide 2%	25.22	21.67	26.00	23.83
Hydrogen cyanamide 3%	25.67	22.67	26.67	23.43
Control (Water only)	10.62	8.26	11.00	8.83
LSD 5%	2.013	1.740	1.446	1.552

Effect of Spraying Some Dormancy Breaking Agents on Initial and Final Fruit Set of Canino Apricot cv: In the first season, it was obvious that initial fruit set was significantly higher (23.76, 25.22 and 25.67 fruits/m) with treatments dormex at 1, 2 and 3%, respectively compared with the other treatments (Table 3), while it was the lowest (10.62 and 11.54 fruits/m) with control and Urea at 5%. Final fruit set recorded the highest values (21.33, 21.67 and 22.67 fruits/m) with hydrogen cyanamide treatments at 1, 2 and 3% compared with the other treatments, while the lowest values (8.26 and 9.33 fruits/m) was found with control and urea at 5% treatments (Table 3).Similar trend was observed in the second season (Table 3). These results are in line with findings by Kuden and Son [12] on Tokaloglu and Karacabey apricot cv. with application of Thiourea 1 or 2% and dormex 1 or 2%, Hegazi *et al*. [9] on Thompson seedless grapevines, by application of dormex at 3 or 5% and urea at 8 or 10%. Son [10] and Mahrous and El-Fakhrani [11] found that application with dormancy breaking agents caused significant increase in initial and final fruit set compared with the control treatment.

Effect of Spraying Some Dormancy Breaking Agents on Fruit Characteristics of Canino Apricot cv: Fruit characteristics were significantly higher with hydrogen cyanamide treatment at 3% compared with the other treatments, while values of fruit characteristics were the lowest with the control compared with the other treatments (Table 4). Also, spraying urea and zinc sulphate with different concentrations improved fruit characteristics compared with the control. Fruit length was significantly higher (5.05, 4.96 and 4.80 cm) with hydrogen cyanamide treatments at 3, 2 and 1%, respectively compared with the other treatments, while it was the lowest (3.38cm) with the control treatment (Table 4). Fruit firmness was significantly higher (10.93 $1b/in^2$) by control treatment compared with the other treatments, while it was the lowest (7.00 $1b/in^2$) with hydrogen cyanamide at (1%) compared with the other treatments (Table 4). Similar trend was observed in the second season (Table 5).Fruit length; diameter and weight were significantly higher (5.26 cm, 4.88cm and 50.33g) with hydrogen cyanamide treatment at 3% compared with the other treatments, while it was significantly lowest (3.46 cm, 3.56 cm and 23.33 g) with control treatment.

Fruit volume, total soluble solids and flesh weight was significantly higher (52.67cm^3, 14.90% and 46.48g) with hydrogen cyanamide treatment at 3% compared with the other treatments, while it was the lowest (24.48 cm^3, 10.50% and 20.53 g) with control treatment.

Table 4: Effect of some dormancy breaking agents on fruit characteristics of Canino apricot cv. in season 2009.

Treatments	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Fruit volume (cm^3)	Fruit length/ diameter ratio	Seed weight (g)	T.S.S %	Fruit firmness (1 b/in^2)	Flesh weight (g)
Urea 5%	3.68	3.61	26.00	28.67	1.01	2.36	12.70	9.50	23.63
Urea 10%	3.60	3.58	26.17	30.67	1.00	2.30	12.93	9.65	23.87
Urea 15%	4.06	4.06	38.37	38.00	0.99	2.83	13.33	9.56	35.54
Zinc sulphate 5%	3.68	3.61	29.18	37.33	1.01	2.77	13.57	9.23	26.41
Zinc sulphate 10%	3.88	3.83	32.95	34.67	1.01	3.24	13.70	9.13	29.70
Zinc sulphate 15%	3.74	3.56	29.24	32.33	1.05	3.23	13.63	8.30	26.00
Hydrogen cyanamide 1%	4.80	4.90	43.00	46.00	0.98	3.70	13.77	7.00	39.30
Hydrogen cyanamide 2%	4.96	4.83	46.33	49.00	1.03	3.80	13.87	7.56	42.53
Hydrogen cyanamide 3%	5.05	4.76	50.48	52.33	1.05	3.86	14.10	7.60	46.95
Control (Water only)	3.38	3.45	22.62	22.67	0.97	2.77	9.83	10.93	19.85
LSD 5%	0.254	0.351	3.667	2.378	0.054	0.230	0.223	0.217	3.699

Table 5: Effect of some dormancy breaking agents on fruit characteristics of Canino apricot cv. in season 2010.

Treatments	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Fruit volume (cm^3)	Fruit length/ diameter ratio	Seed weight (g)	T.S.S %	Fruit firmness (1 b/in^2)	Flesh weight (g)
Urea 5%	3.73	3.65	27.33	29.33	1.01	2.50	12.67	9.53	24.83
Urea 10%	3.68	3.71	26.17	31.67	0.99	2.36	12.80	9.63	23.80
Urea 15%	4.16	4.16	38.67	39.33	0.99	2.86	13.20	9.65	35.81
Zinc sulphate 5%	3.83	3.78	28.83	38.00	1.01	2.79	13.53	9.36	26.04
Zinc sulphate 10%	3.88	3.78	33.00	34.33	1.02	3.28	13.67	9.13	29.72
Zinc sulphate 15%	3.95	3.80	30.33	33.67	1.03	3.33	13.83	8.26	27.00
Hydrogen cyanamide 1%	4.90	4.81	43.00	45.67	1.01	3.51	13.77	7.16	39.48
Hydrogen cyanamide 2%	4.96	4.86	48.00	48.67	1.02	3.85	13.97	7.50	44.15
Hydrogen cyanamide 3%	5.26	4.88	50.33	52.67	1.07	3.85	14.90	7.53	46.48
Control (Water only)	3.46	3.56	23.33	24.48	0.97	2.80	10.50	10.73	20.53
LSD 5%	0.153	0.203	2.129	1.672	0.054	0.236	0.276	0.302	2.217

These results are in parallel with the findings by Kuden and Son [12] on Tokaloglu and Karacabey, Hegazi *et al*. [9] on Thompson seedless grapevines, Son [10] on Tokaloglu and Karacabey apricot cvs and Mahrous and El-Fakhrani [11] that application of dormancy breaking agents improved fruit quality.

CONCLUSION

Finally it could be concluded that:

- Flowering and harvesting time was enhanced with the used treatments science Hydrogen cyanamide and zinc sulphate were effective than urea and control treatments.
- Flower and vegetative bud % was increased by application of used treatments compared with the control.
- Fruit set (initial and final) and fruit characteristics were improved by application of used treatments compared with the control.
- Hydrogen cyanamide at 1, 2, 3% and zinc sulphate at 10 and 15% were preferable as spray than other treatments.

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