BEHAVIOUR OF SUPERIOR GRAPEVINES TO APPLICATION OF SOME REST BREAKING AGENTS AND WINTER PRUNING
I- THE EFFECT OF SOME BREAKING AGENTS

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ABSTRACT

This study was carried out during 2011/2012 and 2012/2013 seasons to throw some lights on the effect of nine chemical and natural rest breaking agents. (Dormex at 4%, brotacion at 4%, garlic oil at 5%, sodium azide at 1%, thiourea at 2%, oils of flax seed, clove and onion each at 5% and H_2O_2 at 5%) on breaking dormancy and improving productivity of Superior grapevines.

Using any one of the nine chemical and natural rest breaking agents was very effective in advancing the start and end of bud burst, shortening duration of bud burst and blooming periods and improving the percentages of bud burst and fruiting buds, all growth aspects, leaf pigments and nutrients, berry setting%, yield and quality of the berries relative to the check treatment. The best chemical and natural rest breaking agents were dormex at 4%, brotacion at 4% and garlic oil at 5%, respectively.

Subjecting the vines to dormex or brotacion each at 4% gave the best results with regard to breaking dormancy and promoting the productivity of Superior grapevines. Under organic farming system, it is suggested to use garlic oil at 5%.

Keywords: Chemical and natural rest breaking agents, Bud burst, growth, yield, berries quality, Superior grapevines.

INTRODUCTION

The increasingly demand for organic fruits as well as the premium prices had motivated farmers to convert from traditional agriculture to organic farming. Taking into account the reduction or elimination of the use of synthetic substances , searching for new alternatives for breaking dormancy of grapevines it is becoming very important.

Using natural dormancy breaking agents as replacement of chemical ones in sustainable agriculture system for breaking dormancy and promoting yield and quality of the berries in different grapevine cvs. was reviewed by many authors (**Abdalla, 2007; Botelho *et al.*, 2007; Botelho *et al.*, 2009; Botelho *et al.*, 2010; Abd El-Wadoud, 2010; Corrales- Maldonado *et al.*, 2010; Eshghi *et al.*, 2010; Mekawy, 2012; Ahmed *et al.*, 2014; Osman, 2014; Ebrahim-Rehab, 2016 and Carvalho *et al.*, 2016**).

The target of the present investigation was examining the effect of some chemical and natural dormancy breaking agents on breaking dormancy and improving productivity of Superior grapevines grown under Fayoum environmental conditions.

MATERIALS AND METHODS

This study was carried out during the two consecutive seasons of 2011/2012 and 2012/2013 on thirty uniform in vigour 8-years old Superior grapevines grown in a private vineyard located at Ahmed Afendy Village, Youssed El-Sediek district, Fayoum Governorate where the soil texture is clay and well drained water since water table depth is not less than two meters. The chosen vines are planted at 2 x 3 meters apart. Cane pruning system was followed at the first week of Jan. leaving 84 eyes per vine (on the basis of six fruiting canes x 12 eyes plus six renewal spurs x two eyes) with the assistance of Baron shape supporting system. The selected vines received the same and common horticultural practices that already applied in the vineyard except the use of rest breaking agents.

This study consisted from the following ten treatments from natural and chemical rest breakages:

1- Control (which vines were sprayed with water only).
2- Spraying Dormex at 4% (40 ml/L).
3- Spraying Brotacion at 4 % (40 ml/L).
4- Spraying Garlic oil at 5% (50 ml/L).
5- Spraying Sodium Azide (NaN_3) at 1% (10 g/L).
6- Spraying Thiourea at 2% (20 g/L).
7- Spraying Flax seed oil at 5% (50 ml/L).
8- Spraying Clove oil at 5% (50 ml/L).
9- Spraying Onion oil at 5% (50 ml/L).
10- Spraying H_2O_2 at 5% (50 ml/L).

Each treatment was replicated three times, one vine per each. All natural and chemical rest breakages were sprayed once (5^{th} and 7^{th} Jan.) when the vines received 140 and 145 chilling hours at equal or below 7.2 ^{o}C during both seasons, respectively in the periods from Nov. 1^{st} till dates of spraying (5 or 7^{th} Jan.). These accumulated chilling hours (140 or 145) at equal or below 7.2 ^{o}C were calculated by using temperature data taken from Fayoum Meteorological Station.

Triton B as a wetting agent at 0.1% was added to all chemical and natural rest breakages before application and the buds were received solutions till runoff (0.25 L/vine).

Table (1): Chemical composition of garlic oils (according to Mnayer *et al*., 2014)

Compounds	Values (mg/100g D.W)
Dipropyl disulfide	0.25
Diallyl disulfide	37.90
Dimethyl trisulfide	0.33
Dimethyl thiophene [a]	0.08
Allyl methyl disulfide	3.69
Methyl propyl disulfide	0.25
Methyl 1-propenyl disulfide [a]	0.46
Allyl propyl sulfide	0.09
Bis-(1-propenyl)-sulfide [a]	0.08
Diallyl sulfide	6.59
Dimethyl disulfide	0.15
Allyl methyl teterosulfide	1.07
Allyl propyl trisulfide	0.23
Dially trisulfide	28.06
Eugenol	0.23

Table (2): Chemical composition of onion oil (Mnayer *et al*., 2014)

Compounds	Values (mg/100g D.W)
1-Propenyl propyl disulfide [a]	7.26
Methyl propyl trisulfide	5.2
Menthone	0.34
Methyl propyl trisulfide	0.47
Dimethyl tetrasulfide	0.15
Dipropyl trisulfide	17.10
Eugenol	3.07
2-Methyl-3,4-dithiaheptane	6.48
Dipropyl tetrasulfide	0.55
Dipropyl disulfide	30.92
Allyl propyl sulfide	0.42
Dimethy trisulfide	0.30

Table (3): Chemical composition of Clove oils (according to Alma *et al.*, 2007).

Compounds	Values %
2-Heptanone	0.04
α-Pinene	0.01
Limonene+1,8 Cineole	0.01
2-Heptyl acetate	0.04
(E)-β-Ocimene	0.33
2-Nonanone	0.02
Linalool	0.01
Methyl salicylate	0.07
p-Allyl phenol	0.19
Eugenol	87.00
α-Copaene	0.10
β-Caryophyllene	3.56
α-Humulene	0.40
Δ-Cadinene	0.04
Eugenyl acetate	8.01
Caryophyllene oxide	0.10
2(12),6(13)-Caryophyllen-dien-5-ol	0.02

Table (4): Chemical composition of Flax seed oil (according to Popa *et al.*, 2012).

Compounds	Values %
Fats%	37
Proteins%	18
Fibre%	25
Carbohydrates%	19
Alanine	4.4
Arginine	9.2
Aspartic acid	9.3
Cystine	1.1
Glutamic acid	19.6
Glycine	5.8
Histidine*	2.2
Isoleucine*	4.0
Leucine*	5.8
Lysine*	4.0
Methionine*	1.5
Phenylalanine*	4.6
Proline	3.5
Serine	4.5
Threonine*	3.6
Tryptophan * c	1.8
Tyrosine	2.3
Valine*	4.6
Palmitic acid	6.58
Stearic acid	4.43
Oleic acid	18.51
Linoleic acid	17.25
Linolenic	53.21

A randomized complete block design (RCBD) was followed where this experiment included ten treatments each treatment replicated three times, one vine per each.

During both seasons, the following parameters were recorded:

1- Percentages of bud burst and fruiting buds and durations of bud burst.

2- Total phenols, ABA, total soluble sugars and total indoles (mg/100g F.W) in the buds just before bud burst **(Gordon and Weber, 1951 and Forcat *et al*., 2008**).

3- Vegetative growth characteristics namely leaf area (**Ahmed and Morsy, 1999**) and wood ripening coefficient (**Bouard, 1966**).

4- Percentages of N, P and K in the leaves (on dry weight basis) (according to **Wilde *et al*., 1985 and Summer, 1985**).

5- Total chlorophylls (chlorophyll a & b) (**Von-Wettstein, 1957**) (mg/100g F.W).

6- Percentage of berry setting.

7- Harvesting date.

8- Yield/vine expressed in weight (kg.) and number of clusters/vine.

9- Cluster weight (g.).

10- Percentage of shot berries.

11- Physical and chemical characteristics of the berries namely berry weight and total soluble solids%, total acidity% expressed as g/ml juice tartaric acid and reducing sugars%(**Lane and Eynon, 1965)** (**A.O.A.C., 2000**).

The obtained data was tabulated and subjected to the proper statistical analysis using new L.S.D. at 5% (**Mead *et al*., 1993**).

RESULTS AND DISCUSSION

1. Percentages of bud burst and fruiting buds and duration of bud burst:

Data in Table (5) clearly show that using the nine chemical and natural rest breakages (dormex at 4%, brotacion at 4%, garlic oil at 5%, sodium azide at 1%, thiourea at 2%, oils of flax seed, clove and onion each at 5% and H_2O_2 at 5%) significantly improved the percentages of bud burst and fruiting buds relative to the control treatment. The best chemical and natural breakages were dormix and garlic oil, respectively. The untreated vines produced the minimum values. These breakages significantly shortened the duration of bud burst. These results were true during both seasons.

2. Total phenols, ABA, total soluble sugars and total indoles in the buds just before bud burst:

It is clear from the data in Tables (5&6) that subjecting the vines to the previous nine chemical and natural rest breakages was significantly accompanied with reducing total phenols and ABA and increasing total indoles and total soluble sugars relative to the control treatment. The effect either in increase or decrease was significantly related to using dormex,

brotacion, garlic oil, sodium azide, thiourea, oils of flax seed, clove and onion and H_2O_2, in descending order. Similar trend was noticed during both seasons.

Table (5): Effect of some chemical and natural breakages on behavior of buds, duration of bud burst, total phenols, ABA and total soluble sugars in the buds before bud burst of Superior grapevines during 2011/2012 and 2012/2013 seasons.

Treatments	Bud burst %		Fruiting buds %		Duration of bud burst (days)		Total phenols (mg/100g F.W)		ABA (mg/100g F.W)		Total soluble sugars (mg/100g F.W)	
	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013
Control	64.4	65.1	39.9	40.0	25.0	24.0	0.69	0.72	0.47	0.50	1.11	1.14
Dormex at 4 %	81.0	81.9	50.3	50.5	10.0	10.0	0.26	0.28	0.23	0.21	1.41	1.50
Brotacion at4 %	79.9	80.7	49.1	49.2	11.0	11.0	0.31	0.31	0.25	0.24	1.36	1.45
Garlic oil at 5 %	74.0	74.7	48.0	47.9	12.0	13.0	0.35	0.34	0.28	0.27	1.33	1.42
NaN_3 at 1 %	72.3	72.9	46.7	46.5	13.0	15.0	0.40	0.37	0.31	0.30	1.31	1.40
Thiourea at 2 %	70.8	71.3	45.5	45.4	15.0	17.0	0.45	0.43	0.33	0.33	1.28	1.37
Flax seed Oil at 5 %	70.0	70.5	44.4	44.2	17.0	19.0	0.51	0.50	0.35	0.37	1.25	1.34
Clove oil at 5 %	68.3	69.0	43.3	43.0	19.0	20.0	0.56	0.54	0.38	0.40	1.21	1.30
Onion oil at 5 %	66.9	68.1	42.2	42.0	21.0	21.0	0.60	0.58	0.41	0.43	1.18	1.27
H_2O_2 at 5 %	65.6	67.0	41.1	41.0	23.0	23.0	0.64	0.62	0.44	0.47	1.15	1.24
New L.S.D at 5%	**0.8**	**0.7**	**1.0**	**0.9**	**2.0**	**2.0**	**0.03**	**0.03**	**0.02**	**0.02**	**0.02**	**0.02**

3. Growth and leaf chemical components:

It is clear from the data in Tables (6&7) that using any one of the previous nine chemical and natural rest breakages significantly stimulated the leaf area, wood ripening coefficient, N, P, K and total chlorophylls in the leaves rather than the control treatment. The best chemical and natural rest breakages were dormex and garlic oil, respectively. The maximum values were recorded on the vines that treated with dormex at 4%. Untreated vines produced the lowest values. Similar trend was noticed during both seasons.

4. Berry setting%, yield and cluster weight:

Table (7) shows that berry setting %, yield expressed in weight and number of clusters/vine and cluster weight were significantly improved in response to treating the vines with any one of the previous nine rest breakages relative to the control treatment. The best breakages in improving berry setting, yield and cluster weight cane be arranged as follows, in descending order dormex, brotacion, garlic oil, sodium azide, thiourea, oils of flax seed, clove and onion and H_2O_2. The vines treated with dormex at 4% produced yield/vine reached 8.5 & 12.8 kg while untreated vines produced 6.7 & 6.8 kg during both seasons, respectively. The percentage of increment on the yield due to using the previous promised treatment over the check treatment teached 26.9 and 88.2% during 2011/2012 & 2012/2013 seasons, respectively.

Table (6): Effect of some chemical and natural breakages on the total indoles in the buds before bud burst, leaf area, wood ripening coefficient and percentages of N, P and K in the leaves of Superior grapevines during 2011/2012 and 2012/2013 seasons.

Treatments	Total indoles (mg/100g F.W		Leaf area $(cm)^2$		Wood ripening coefficient		Leaf N %		Leaf P %		Leaf K %	
	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013
Control	0.05	0.04	101.9	102.0	0.55	0.56	1.64	1.59	0.08	0.07	1.41	1.44
Dormex at 4 %	0.27	0.27	118.0	119.3	0.92	0.87	2.40	2.43	0.28	0.27	1.92	1.95
Brotacion at 4 %	0.25	0.25	116.4	117.7	0.89	0.84	2.30	2.33	0.24	0.25	1.82	1.85
Garlic oil at 5 %	0.22	0.24	114.4	115.7	0.84	0.80	2.19	2.25	0.22	0.22	1.76	1.79
NaN_3 at 1 %	0.20	0.21	113.0	114.5	0.79	0.76	2.09	2.17	0.20	0.20	1.71	1.74
Thiourea at 2 %	0.18	0.17	111.5	112.9	0.75	0.73	1.98	2.07	0.18	0.17	1.68	1.73
Flax seed oil at 5 %	0.15	0.14	110.0	110.9	0.71	0.70	1.88	1.97	0.16	0.15	1.64	1.69
Clove oil at 5 %	0.13	0.11	108.0	108.9	0.67	0.66	1.86	1.90	0.14	0.13	1.60	1.64
Onion oil at 5 %	0.10	0.09	105.7	106.0	0.64	0.63	1.79	1.80	0.12	0.11	1.53	1.57
H_2O_2 at 5 %	0.08	0.06	103.9	104.0	0.59	0.60	1.71	1.66	0.10	0.09	1.46	1.50
New L.S.D at 5%	**0.02**	**0.02**	**1.4**	**1.2**	**0.03**	**0.03**	**0.06**	**0.06**	**0.02**	**0.02**	**0.04**	**0.04**

Table (7): Effect of some chemical and natural breakages on total chlorophylls, berry setting, number of clusters/vine, yield/vine, harvesting date and cluster weight of Superior grapevines during 2011/2012 and 2012/2013 seasons.

Treatments	Total chlorophylls (mg/100 F.W)		Berry setting %		No. of clusters/vine		Yield/vine (kg)		Harvesting date		Avr. cluster weight (g.)	
	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013
Control	3.9	3.7	10.1	9.9	19.0	20.0	6.7	6.8	25 June.	27 June.	350.0	340.0
Dormex at 4 %	9.1	9.1	20.5	20.3	20.0	30.0	8.5	12.8	5 June.	4 June.	425.0	428.0
Brotacion at 4 %	8.5	8.6	19.4	19.2	20.0	28.0	8.4	11.8	6 June.	6 June.	420.0	423.0
Garlic oil at 5 %	7.9	8.1	18.3	18.1	19.0	26.0	7.8	11.7	8 June.	8 June.	410.0	412.0
NaN_3 at 1 %	7.4	7.5	17.2	17.0	19.0	24.0	7.6	10.7	10 June.	10 June.	400.0	402.0
Thiourea at 2 %	6.7	6.9	16.1	15.9	19.0	24.0	7.4	10.7	12 June.	12 June.	390.0	393.0
Flax seed oil at 5 %	6.2	6.3	15.0	14.8	19.0	22.0	7.2	8.4	14 June.	14 June.	379.0	380.0
Clove oil at 5 %	5.5	5.7	13.7	13.5	19.0	22.0	7.0	8.2	18 June.	16 June.	371.0	373.0
Onion oil at 5 %	5.1	5.0	12.6	12.5	19.0	21.0	7.0	7.8	20 June.	18 June.	368.0	370.0
H_2O_2 at 5 %	4.6	4.5	11.5	11.3	19.0	21.0	6.8	7.6	22 June.	21 June.	359.0	360.0
New L.S.D at 5%	**0.4**	**0.4**	**1.0**	**1.1**	**NS**	**2.0**	**0.2**	**0.4**	--------	--------	**9.0**	**8.8**

5. Harvesting date:

It is evident from the data in Table (7) that harvesting date was greatly advanced with using any one of the previous nine rest breakages comparing to the check treatment. The promotion and enhancement in date of harvesting was associated with using dormex, brotacion, garlic oil, sodium azide, thiourea, oils of flax seed, clove and onion and H_2O_2, in descending order. The best advancement in harvesting date was observed on the vines that exposed to dormex (5 & 4 June), brotacione (6 June) and garlic oil (8 June), in descending order during both seasons, respectively. The great delayness on harvesting date was recorded on untreated vines.

6. Percentage of shot berries:

Table (8) shows that shot berries% was significantly depressed with using any one of the rest breakages relative to the control treatment. The best chemical agents in controlling such unfavourable phenomenon were Dormex at 4% followed by brotacion at 4%, garlic oil at 5% occupied the first position among all the natural rest breakages. The minimum values (4.1 & 3.7%) were recorded on the clusters from vines treated with dormex during both seasons, respectively. The highest values (9.1 & 8.8%) were revealed on the clusters harvested from untreated vines during 2011/2012 & 2012/2013 seasons. Similar trend was noticed during both seasons.

Table (8): Effect of some chemical and natural breakages on shot berries%, berry weight and percentages of T.S.S ,total acidity and reducing sugars in the berries of Superior grapevines during 2011/2012 and 2012/2013 seasons.

Treatments	Shot berries %		Avr. berry weight (g.)		T.S.S.%		Total acidity %		Reducing sugars %	
	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013
Control	9.1	8.8	3.11	3.21	18.0	17.9	0.719	0.715	15.9	16.1
Dormex at 4 %	4.1	3.7	3.77	3.80	20.6	20.5	0.548	0.539	18.4	18.2
Brotacion at 4 %	5.4	4.9	3.70	3.73	20.3	20.3	0.568	0.560	18.2	18.0
Garlic oil at 5 %	5.9	5.6	3.64	3.67	20.0	20.0	0.588	0.580	18.0	17.9
NaN_3 at 1 %	6.4	6.1	3.55	3.58	19.7	19.7	0.605	0.601	17.6	17.5
Thiourea at 2 %	6.8	6.4	3.46	3.50	19.4	19.4	0.629	0.618	17.3	17.2
Flax seed oil at 5 %	7.3	6.0	3.40	3.42	19.1	19.1	0.644	0.640	17.0	16.9
Clove oil at 5 %	7.7	6.5	3.31	3.34	18.8	18.8	0.660	0.659	16.8	16.7
Onion oil at 5 %	8.2	7.4	3.24	3.26	18.6	18.5	0.680	0.679	16.6	16.5
H_2O_2 at 5 %	8.6	7.9	3.17	3.20	18.3	18.2	0.701	0.699	16.3	16.2
New L.S.D at 5%	**0.4**	**0.4**	**0.04**	**0.05**	**0.3**	**0.3**	**0.015**	**0.014**	**0.2**	**0.2**

7. Quality of the berries:

It is revealed from the data in Table (8) that subjecting the vines to any one of the previous nine rest breakages was significantly very effective in improving quality of the berries in terms of increasing berry weight, T.S.S. and reducing sugars% and decreasing total acidity% over the control treatment. Using dormex, brotacion, garlic oil, sodium azide, thiourea, oils of flax seed, clove and onion and H_2O_2, in descending order was significantly very effective in improving quality of the berries. The best chemical and natural breakages were dormex and garlic oil, respectively. Using H_2O_2 occupied the last position in this respect among the nine rest breakages. Similar trend was noticed during both seasons.

DISCUSSION

The positive action of chemical rest breakages on breaking dormancy and improving productivity of Superior grapevines might be attributed to one or more of the following reasons (**Pinto *et al*., 2007; Grappal and Benvides, 2008 and Dong-Mei *et al*, 2011**).

1- Removing bud scales.

2- Increasing free water, IAA, GA_3, cytokinines, soluble sugars, amino acids, total indoles, oxidative process, peroxidase, H_2O_2 and polyamines.

3- Reducing ABA, total phenols, catalase enzyme and glutathione.

These results are in agreement with those obtained by **Abdalla, (2007); Ahmed *et al*., (2014); Osman, (2014); Ebrahim-Rehab, (2016) and Carvalho *et al*., (2016).**

The beneficial effects of plant oils on breaking endodormancy and promoting the yield of Superior grapevines might be attributed to their higher content of sulfur-containing compounds, amino acids and various volatiles. Sulphur is a constitute of the three amino acids systene, cysteine and methionine and hence proteins. They play definite roles in enhancing the biosynthesis of GA_3 indoles, free water, total carbohydrates and most organic foods and reducing phenols and ABA (**Kubota *et al*., 2000**).

The present effect of plant extracts on ending bud dormancy and improving the yield and quality of the berries in Superior grape cv. was supported by the results of **Ahmed *et al*., (2014); Osman, (2014); Carvalho *et al*., (2016) and Ebrahim-Rehab, (2016).**

CONCLUSION

Subjecting Superior grapevines once when the vines received 140 and 145 chilling hours during both seasons, respectively below or equal 7.2^{o}C with dormex at 4% or brotacion at 4% have satisfactory results with regard to breaking dormancy and improving yield and quality of the berries. Under organic farming system, it is advised to use garlic oil at 5%.

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سلوك كرمات العنب السوبيريور لاستخدام بعض كاسرات السكون والتقليم الشتوى

١- تأثير بعض كاسرات السكون

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أجريت هذه الدراسة خلال موسمى ٢٠١٢/٢٠١١، ٢٠١٣/٢٠١٢ بهدف إلقاء المزيد من الضوء علي تاثير تسعة كاسرات سكون طبيعية وكيميائية (الدورميكس بتركيز ٤% - البروتاسيون بتركيز ٤% وزيت الثوم بتركيز ٥% - أزايد صوديوم بتركيز ١% - الثيوريا بتركيز ٢% وزيوت بذرة الكتان والقرنفل والبصل بتركيز ٥% وفوق أكسيد الهيدروجين بتركيز ٥%) علي كسر السكون وتحسين انتاجية كرمات العنب السوبيريور.

كان استخدام أى مادة كيميائية وطبيعية كاسرة للسكون فعالا جدا فى التبكير فى موعد بداية ونهاية تفتح البراعم – وتقصير فترة تفتح البراعم وتحسين النسبة المئوية لتفتح البراعم والبراعم الثمرية ومساحة الورقة ومعامل نضج الخشب والكلوروفيل الكلى وعناصر النيتروجين والفسفور والبوتاسيوم فى الورقة ، النسبة المئوية لعقد الحبات وكمية المحصول وخصائص الجودة للحبات مقارنة بمعاملة الكونترول وكانت أفضل المواد الكيميائية والطبيعية هى الدورميكس بتركيز ٤% والبروتاسيون ٤% وزيت الثوم بتركيز ٥% علي التوالي-

إن معاملة كرمات العنب السوبيريور بالدورميكس بتركيز ٤% أو البروتاسيون بتركيز ٤% أعطى أفضل النتائج فى كسر السكون وتحسين انتاجية كرمات العنب السوبيريور. وفى نظام الزراعات العضوية والنظيفة فانه يمكن استخدام زيت الثوم بتركيز ٥%.

الكلمات الدالة: كاسرات السكون الطبيعية والكيميائية- تفتح البراعم – النمو – خصائص الجودة للحبات- كمية المحصول- كرمات العنب السوبيريور