

## Improvement the Production of Red Roomy Grapevines under Warm Climatic Conditions

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### Abstract

This experiment was carried out at the Experimental station of the faculty of Agriculture, Assiut University during two successive seasons 2016/2017 on Red Roomy grapevines. The beneficial effects of spraying Dormex at 4%, Salicylic acid at 5%, Garlic oil at 2%, camphor oil at 2% and Lemon grass oil at 2% on bud break and improve the Red Roomy production under warm climate were investigated. The experiment was arranged in a complete randomized design with three replicates per treatment, one vine per each. The results indicated that all treatments were very effective on breaking bud dormancy and improving the yield and quality of the berries compared with the check treatments. The best results regarding the improvement of cluster compactness coefficient, number of berries and berry setting were obtained with spraying lemon grass oil at 2% and camphor oil at 2%. No significant differences were found between Dormax and the other compounds.

It could be concluded that using plant extracts i.e lemon grass oil, camphor oil and garlic oil as natural and safety substances were very effective to break bud dormancy and improve the grapevines fruiting.

**Keywords:** *Red Roomy, natural products, break dormancy, Dormex, salicylic acid*

### Introduction

Grapes are one of the most important fruit crops for local consumption and export. It is considered as one of the most popular and favorite fruits in the world, because of an excellent flavor, nice taste and high nutritional value. The total world area of grapevines reached 10.5 million ha with a total production of 89 million ton fruits per year (F.A.O. 2015). Red Roomy is considered one of the most important seeded grape varieties grown in Egypt. The biggest problem faced the producers of Red Roomy grape cultivar in Assiut governorate is the delay and irregular bud break. Delaying and irregularity of bud break led to lower fruit set than expected due to occurrence at very high

temperature during May (El- Sese and Mohamed 2003). Delaying and irregularity of bud break in numerous deciduous fruit crops are due to insufficient chilling hours necessary for complete bud break and terminate bud dormancy (Sparks, 1993, El-sese and Mohamed, 2003). Under warm conditions, there is a great need for artificial means to compensate the lack of natural chilling requirements to gain an economic production of dessert grapes (Or *et al.* 2000 and EL-Salhy 2002). Dormex (hydrogen Cyanamid) and the related compounds containing cyanamid has been widely used for terminating bud dormancy hastening, improving and regulating bud burst as well as increasing yield and improving berry quality in

different grapevine cultivars (Omran 2000, EL-Salhy 2002 and Ben Mohamed *et al.* 2012). Dormex is a toxic and expensive compound, so it is necessary to replace it with new natural agents. Such agents must be easily available, effective and not toxic for human and plant. Plant extracts as natural products were used for improving growth, nutritional status and as pesticides for maintenance public health and environmental safety. Plant extracts containing phenolic compounds and other chemical constituents have synergistic effects on growth and fruiting of fruit trees. It can be used as natural and safety substances for breaking bud dormancy (Paik and Chung. 1997 and Srivastava and Lal, 1997 and Ahmed *et al.* 2014). Maldonado *et al.* (2010) examined the effect of garlic compounds on bud break dormancy and cluster quality in four table grape cultivars. They reported that Cluster weight and berry size of table grapevine cultivars were largest with best quality due to use garlic compound. Lemon grass oil is the essential oil obtained from the aerial parts of cymbopogon citrates, this plant has been widely recognized for its ethno botanical and medicinal usefulness (Oyedele *et al.* 2002). Gouda (2016) concluded that spraying lemon grass oil twice at 1% improved the production of Ruby Seedless grapevines. Salicylic acid is an endogenous plant growth regulator with phenolic nature and classified as a growth promoter. Moreover, it enhanced plant vigor under biotic and abiotic stresses. It has an important role in reducing the activity of catalase and increasing the release of  $H_2O_2$  (Srivastava and

Dwivedi 2000, Zhang *et al.* 2003 and Hayat *et al.* 2010). Salicylic is a new plant hormone and has been shown to interfere with the biosynthesis and action of ethylene, ABA, and cytokinins. As well as, it can inhibit the abiotic stresses (Joseph *et al.* 2010 and Hayat *et al.* 2010) and has many important regulatory effects such as enhancing growth, yield and quality of berries in different grapevine cultivars (El-Hanafy 2011 and Mohamed - Ebtesam 2012).

The present study aimed to study the effect of some plant extracts vs hydrogen cyanamid on breaking bud dormancy and improving productivity of Red Roomy grapevines growing under warm climates.

#### **Materials and Methods**

This study was carried out during 2016 and 2017 seasons on eighteen uniform Red Roomy grapevines. Vines were 25 years old at the beginning of experiment and spaced at 2x2.5m apart. The vines were grown at the Experimental orchard of the Faculty of Agriculture, Assiut University, Egypt. Head pruning system was applied by leaving a total bud load of 72 buds /vine for all the selected vines on the basis of 15 fruiting spurs x4 buds plus 6 replacement spurs x 2 buds/vine. The chosen vines were received the usual horticultural practices which are used in the vineyard. The experiment was arranged in a complete randomized design with three replicates per treatment, one vine per each.

The experiment contained six treatments as follow:

1. Spraying with Dormex at 4% (2% hydrogen cyanamid)
2. Spraying with camphor oil at 2%
3. Spraying with lemon grass oil at 2%
4. Spraying with garlic oil at 2%
5. Spraying with salicylic acid at 5%
6. Control (spraying with water)

The selected vines were sprayed during the first week of February in both seasons. Salicylic acid was dissolved in a few drops of ethyl alcohol. Another compounds were prepared by dissolving the assigned amounts in the required quantities of water. All vines were sprayed until the run – off point. Triton B at 0.1% as a wetting agent was used. The following measurements were recorded during the both seasons of study.

#### 1- Date of bud burst and its percentage:

Date of bud burst was recorded and then the number of burst buds/vine was recorded. The percentages of bud burst were calculated by dividing the number of burst bud /vine by total number of buds per vine at weekly interval along the bursting period.

#### 2- Fruiting buds%.

The fruiting buds% were calculated by dividing the number of fruity buds numbers by total number of buds/vine.

#### 3- Vegetative growth parameters:

##### a- Average leaf area (cm<sup>2</sup>).

Average leaf area was estimated by weighting ten mature leaves/ vine and weighting 40 sections of 1 cm<sup>2</sup> (4 sec. of 1 cm<sup>2</sup>/ leaf), then the leaf area (cm<sup>2</sup>) was estimated according to the equation:

$$\text{Leaf area cm}^2 = \frac{\text{leaves weight (g)} \times \text{section area (cm}^2\text{)}}{\text{section weight (gm)}}$$

##### b- Weight of pruning wood:

Weights of pruning wood were calculated immediately after pruning (January, 15) and expressed as g/vine.

#### 4- Yield components:

Berry set percentage was estimated by caging five flower clusters on each vine in perforated paper bags before bloom. After berry set the bags were removed and the percentage of berry set was calculated as follows:

$$\text{Berry set \%} = \frac{\text{No. of berries/cluster} \times 100}{\text{total of flowers/cluster}}$$

At harvest date the following parameters were recorded: number of cluster /vine, average cluster weight and total yield as kg/vine.

#### 5- Fruit quality:

Cluster length, weight of 100 berries, number of berries/cluster and cluster compactness coefficient were determined according to Winkler *et al.* (1974). Berry chemical quality in terms of total soluble solids (T.S.S) was measured using hand refractometer, reducing sugars percentage were determined as outline in A.O.A.C (1985), and titratable acidity (TA) was determined by direct titration with 0.1N NaOH using phenolphthalein as an indicator and expressed as mg tartaric acid per 100 ml juice according to A.O.A.C (1985). Total anthocyanin (mg/100 ml juice) using Ethyl alcohol and HCL at 85:15 and the optical density was determined using spectrophotometer at wave length 532 Markham (1982).

## Statistical analysis

The obtained data was subjected to the analysis of variances according to (Senedecor and Cochran 1990). LSD at 5% level was used to compare the differences between the treatment means

## Results

### 1- Environmental Condition:

Data in Table (1) showed the average of monthly temperatures in the experimental location during the two seasons of this study. The mean

monthly temperature ranged from 15.25 & 14.38°C in December to 19.80 & 18.91°C in March, which is insufficient for winter chilling to overcome dormancy. In this regard, Weaver (1976) showed that grapes usually require a winter in dormancy of about 2 months, with an average daily mean temperature below (10°C).

**Table 1. Monthly Weather, Maximum, minimum and mean of temperature of 2015/2016 and 2016/2017 seasons**

	2015/2016			2016/2017		
	Temperature (°C)			Temperature(°C)		
	Max.	Min.	Mean	Max.	Min.	Mean
<b>Nov.</b>	28.00	13.40	20.70	28.83	12.80	20.82
<b>Dec.</b>	23.10	7.40	15.25	21.90	6.86	14.38
<b>Jan.</b>	23.80	8.00	15.90	20.99	4.96	12.98
<b>Feb.</b>	26.20	7.00	16.60	22.97	5.39	14.18
<b>Mar.</b>	26.20	13.40	19.80	27.08	10.73	18.91
<b>Apr.</b>	33.40	12.40	22.90	33.22	14.39	23.81

After, Assiut Weather station.

### 2- Effect of treatments on bud behavior

Results in Table (2) showed the effect of treatment on bud burst %, fruiting bud % and date of bud burst of Red Roomy grapevines in 2016 and 2017 seasons. The results took the similar trend during the two studied seasons. All treatments significantly increased the percentage of bud burst and fruiting buds as well as the advancement of they advanced bud burst and blooming over the check treatments. The highest bud burst percentages (88.89%) as an average of the two studied seasons were recorded on the vines that received Dormex at 4%, followed by lemon grass oil at 2% (87.5%). The fruiting buds percentage were 45.85 &

44.70% as an average. Of the two studied seasons due to garlic oil at 2% and salicylic acid at 5%, respectively. Dormex at 4% exhibited the early date of bud burst (11 Mar) followed by garlic oil at 2% (12 Mar) as an average of the two studied seasons. On the other hand, untreated vines recorded the lowest values of such traits (bud burst 54.86%), fruiting buds (27.07%) and the date of bud burst (30 Mar) as an average of the two studied seasons. The early days of bud burst compared to control were 19, 8, 12, 18 and 11 days (as an average of the two studied seasons) for Dormex, camphor oil, lemon grass oil, garlic oil and salicylic acid, respectively. The corresponding increment percentage of bud burst%

and fruiting buds% for the above mentioned treatments over the control were 59.30, 55.67, 59.50, 58.24 and 51.87% and 54.19, 52.60, 53.27, 64.57 and 65.13% as an average. Of the two studied seasons, respectively. No significant differences were found among treatments regarding bud burst and fruiting bud percentage.

### 3- Effect of treatments on vegetative growth.

Table (2) exhibits the effect of studied treatments on some growth characteristics. Data showed that all used compounds significantly increased the leaf area and pruning weight over the check treatments. The maximum values of leaf area were recorded on the vines that received Dormex at 4% (180.44 cm<sup>2</sup>) followed by camphor oil at 2% (180.18 cm<sup>2</sup>) as an average of two studied seasons. Meanwhile, the maximum values of pruning weight were noticed due to spray garlic oil and camphor oil at 2% (1.57 and 1.55 kg as an average, of the two studied seasons), respectively. The untreated vines gave the lowest values of their leaf area and pruning wood weight due spray garlic oil and camphor oil at 2%. No significant differences

were found due to use any plant oils compared to Dormex during the two studied seasons.

### 4- Effect of treatments on yield components:

It is evident from the data in Table(3) that spraying Dormex, salicylic acid and natural oils significantly increased the berry set% number of clusters/ vine and yield/vine compared to unsprayed ones in both seasons. Salicylic acid, garlic oil and lemon grass oil were the most effective in this concern compared to the other treatments. No significant differences were detected among salicylic acid, garlic oil and lemon grass oil. The heaviest yield was recorded on vines that sprayed with salicylic acid at 5% (13.41 kg/vine) and lemon grass oil at 2% (13.05 kg/vine as an average of two studied seasons). The untreated vines produced the lowest yield (6.29kg/vine as an average of two studied seasons). Hence, the increment percentage of yield / vine over untreated ones were attained 78.22, 86.80, 107.47, 104.77 and 113.20% as an average of the two studied seasons due to spray Dormex, camphor oil, lemon grass oil, garlic oil and salicylic acid, respectively.

**Table 2. Effect of Dormex , some plant oils and salicylic acid on bud burst%, fruiting buds%, date of bud burst, earliest/day leaf area (cm<sup>2</sup>) and pruning weight (kg) of Red Roomy grapevines during 2016 and 2017 seasons.**

Treatment No.	Bud burst%			Fruiting buds%			Date of bud burst			Leaf area (cm <sup>2</sup> )			Pruning weight (kg)			
	2016	2017	Mean	2016	2017	Mean	2016	Earliness/day	2017	Earliness/day	2016	2017	Mean	2016	2017	Mean
T1	86.50	88.28	87.39	38.96	44.51	41.74	12/Mar	18	9/Mar	20	175.53	185.34	180.44	1.45	1.59	1.52
T2	83.30	87.50	85.40	38.57	44.04	41.31	24/Mar	6	19/Mar	10	178.22	182.15	180.18	1.51	1.58	1.55
T3	87.50	87.50	87.50	39.58	43.40	41.49	20/Mar	10	15/Mar	14	176.50	181.46	178.98	1.48	1.57	1.53
T4	86.11	87.50	86.81	43.56	45.53	44.55	9/Mar	21	14/Mar	15	176.68	180.16	178.42	1.48	1.65	1.57
T5	81.90	84.63	83.27	44.17	45.22	44.70	20/Mar	10	18/Mar	11	174.80	178.10	176.45	1.47	1.56	1.52
T6	52.78	56.94	54.86	25.94	28.19	27.07	30/Mar	---	29/Mar	---	159.84	163.18	161.51	1.21	1.29	1.25
L.S.D(5%)	4.11	4.65		3.25	3.66						6.48	7.60		0.07	0.06	

**Table 3. Effect of Dormex, some plant oils and salicylic acid on berry setting% , number of clusters/vine and yield/vine (kg) of Red Roomy grapevines during 2016 and 2017 seasons.**

Treatment No.	Berry setting%			Number of clusters/ vine			Yield/Vine (kg)		
	2016	2017	Mean	2016	2017	Mean	2016	2017	Mean
T1	9.69	10.18	9.94	26.33	30.33	28.33	10.35	12.07	11.21
T2	10.18	10.98	10.58	26.13	28.63	27.38	11.11	12.40	11.75
T3	10.11	10.85	10.48	27.50	30.30	28.90	12.23	13.87	13.05
T4	9.87	9.99	9.93	29.80	32.66	31.23	12.13	13.65	12.89
T5	9.75	10.63	10.19	29.50	31.70	30.60	12.83	13.98	13.41
T6	7.42	8.18	7.8	18.68	20.30	19.49	6.10	6.48	6.29
L.S.D at 5%	0.58	0.66		1.34	1.86		0.68	0.73	

T1=Dormex , T2= Camphor oil, T3= Lemon grass oil, T4= Garlic oil, T5= salicylic acid, T6= Control

### 5-Effect of treatments on cluster and berry attributes:

Data presented in Table (4) show the effect of Dormex at 4%, camphor oil at 2%, lemon grass oil at 2%, garlic oil at 2% and salicylic acid at 5% on cluster weight, number of berries/cluster, cluster length, compactness coefficient and berry weight of Red Roomy grapevines during 2016 and 2017 seasons. Generally, data indicated that all spraying treatments significantly increased these traits compared to the control. The maximum value of cluster weight (450.15g), number of berries (105.95) and compactness coefficient (4.16%) (as an average of the two studied seasons) were recorded due to spray with lemon grass oil, whereas, camphor oil gave the maximum value of cluster length (26.10 cm as an average of the two studied seasons). Moreover salicylic acid gave the highest value of berry weight (3.62g as an average of the two studied seasons). In the contrary; the control treatment gave the minimum values of all the studied cluster traits. The increment percentage of cluster weight and compactness coefficient were 37.75 & 17.51% (as an average of the two studied seasons) due to spray lemon grass oil compared to unsprayed vines.

Data presented in Tables (4&5) indicated that spraying Dormex, salicylic

acid and natural oils significantly improved the berry quality in terms of increasing berry weight, reducing sugars%, T.S.S% as well as berry anthocyanin content and decreasing total acidity % compared to check treatment. The maximum values of berry weight (3.62g), T.S.S (19.17%) and anthocyanin (1.78 mg /g fw) as an average of the two studied seasons was noticed with spray salicylic acid at 5%, meanwhile the highest value of reducing sugars (16.29%) as an average of the two studied season was recorded due to spray with Dormex at 4%. On the other hand, the least value of total acidity (0.337%) (as an average of the two studied seasons) was recorded when the vines were sprayed with salicylic acid followed by Dormex (0.339%). The lowest values of berry weight, anthocyanin, reducing sugars and T.S.S (3.16, 0.70 & 13.66 and 15.50% as an average of the two studied seasons) were recorded on untreated vines which also gave the highest value of total acidity % (0.497% as an average of the two studied seasons). Hence the incensement percentage of berry weight due to such treatments over the untreated ones was 11.39, 10.13, 12.66, 12.97 and 14.55% due to use Dormex, camphor oil, lemon grass oil garlic oil and salicylic acid, respectively.

**Table 4. Effect of Dormex, some plant oils and salicylic acid on cluster weight (g), number of berries, cluster length(cm) and compactness coefficient of Red Roomy grapevines during 2016 and 2017 seasons.**

Treatment No.	Cluster weight (g)			Number of berries			Cluster length (cm)			Compactness coefficient			Berry weight (g)		
	2016	2017	Mean	2016	2017	Mean	2016	2017	Mean	2016	2017	Mean	2016	2017	Mean
T1	393.30	398.50	395.90	100.80	101.50	101.15	25.30	26.40	25.85	3.98	3.85	3.92	3.41	3.63	3.52
T2	425.50	433.30	429.40	104.30	108.70	106.50	26.00	26.20	26.10	4.01	4.30	4.16	3.40	3.56	3.48
T3	445.00	455.30	450.15	104.60	107.30	105.95	24.70	26.30	25.50	4.24	4.08	4.16	3.67	3.67	3.56
T4	407.30	418.40	412.85	100.80	102.20	101.50	25.40	26.30	25.85	3.97	3.89	3.93	3.51	3.63	3.57
T5	435.70	441.50	438.60	100.20	104.80	102.50	25.0	26.4	25.70	4.01	3.97	3.99	3.46	3.78	3.62
T6	325.80	318.40	322.10	85.80	89.30	87.55	24.6	23.8	24.20	3.36	3.71	3.54	3.08	3.28	3.16
L.S.D at 5%	16.13	19.81		3.96	3.58		0.93	1.18		0.16	0.21		0.21	0.26	

T1=Dormex, T2= Camphor oil, T3= Lemon grass oil, T4= Garlic oil, T5= salicylic acid, T6= Control

**Table 5. Effect of Dormex, some plant oils and salicylic acid on reducing sugars%, anthocyanin mg/g, T.S.S% and acidity% of Red Roomy grapevines during 2016 and 2017 seasons.**

Treatment No.	Reducing sugars%			Anthocyanin mg/g			T.S.S%			Acidity%		
	2016	2017	Mean	2016	2017	Mean	2016	2017	Mean	2016	2017	Mean
T1	15.86	16.73	16.29	1.74	1.77	1.76	18.67	19.50	19.09	0.396	0.283	0.339
T2	16.25	15.87	16.06	1.66	1.69	1.68	19.00	18.25	18.63	0.386	0.303	0.345
T3	15.88	16.17	16.03	1.67	1.72	1.70	18.85	19.18	19.02	0.373	0.330	0.352
T4	15.53	16.32	15.93	1.66	1.72	1.69	18.20	19.67	18.94	0.366	0.317	0.342
T5	16.11	16.36	16.24	1.75	1.80	1.78	19.00	19.33	19.17	0.332	0.341	0.337
T6	13.47	13.85	13.66	0.68	0.72	0.70	15.33	15.67	15.50	0.543	0.450	0.497
L.S.D at 5%	0.87	1.10		0.11	0.09		0.51	0.48		0.013	0.018	

T1=Dormex, T2= Camphor oil, T3= Lemon grass oil, T4= Garlic oil, T5= salicylic acid, T6= Control

## Discussion

Dormex had a positive action on breaking dormancy and improving vegetative growth and fruit quality of Red Roomy grapevines due to its effect on removing buds scales, reducing ABA, catalase, reduced and oxidized glutathione and enhancing free water, IAA, GA<sub>3</sub>, cytokines, soluble sugars, amino acids, total indoles, oxidative stress, H<sub>2</sub>O<sub>2</sub>, total free polyamines and enzymes activities (Rady and Seif-El Yazel, 2013 and Mohamed and Goud 2017). Spraying camphor oil advanced bud burst, floral buds and enhanced floral buds of Flame seedless and Thompson Seedless grapevines (Mustafa *et al.* 2015). The positive action of garlic oil on breaking bud dormancy in grapevines may be due to its contents of sulfur containing compounds (allyl group

and mono- di tri and tetra sulfides), volatiles, tannins, phenols antioxidants, vitamins and amino acids and cysteine, such compounds act as a precursor for the synthesis of garlic oil containing reduced sulphur as well as for other biosynthesis pathways such as the formation of ethylene. Lemon grass oil is mainly comprised of monoterpenes compound like citral (65- 80 %), citral (3,7 – dimethyl – 2,6 – octadienal) is a mixture of monoterpene aldehydes, isomers nerol and geraniol. The other important functional components include limonene, citronella, monoterpene olefins, such as  $\alpha$ -myrcene, and alcoholic polar compound geraniol (Schaneberg & Khan 2002). It is used in the manufacture of synthetic vitamin volatiles, phenols, antioxidants and plant pigments (Masamba *et al.* 2003). Sali-

cyclic acid enhancing H<sub>2</sub>O<sub>2</sub> and natural hormone and reducing ethylene biosynthesis, such effects could explain the present results (Hayat *et al.* 2010). Moreover, Abd EL- Kareem (2009), EL- Kady – Hanaa (2011) and EL- Hanafy (2011) confirmed the present results concerning the positive action of salicylic acid on fruiting of grapevines. The obtained results of this experiment are in line with those found by EL- Halaby (2009), Abdalla (2007), Mekawy (2008), El-Sawy (2009), Biasia *et al.* (2010), Ahmed *et al.* (2014), Mostafa *et al.* (2015) and Mohamed and Gouda. (2017) who studied bud breaking and fruiting of grape.

### Conclusion

Generally, it can be concluded that plant extracts such as lemon grass oil, camphor oil and garlic oil as natural and safety substance can be used instead of synthetic chemical for breaking Dormancy and improving yield and quality of Red Roomy grapevines growing under hot climate.

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## تحسين انتاجية شجيرات العنب الرومى الاحمر تحت ظروف المناخ الدافئ

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### الملخص:

اجريت هذه الدراسة خلال موسمى ٢٠١٦، ٢٠١٧ على شجيرات العنب الرومى الاحمر المنزرعة فى مزرعة الفاكهة التابعة لكلية الزراعة جامعة اسيوط بهدف دراسة تأثير الرش بالدورميكس (٤%) وحمض السالسلبيك (٥%) وبتركيز ٢% من زيت الثوم وزيت الكافور وزيت حشيشة الليمون وذلك فى الاسبوع الاول من شهر فبراير على تفتح البراعم والمحصول وجودة الثمار.

ولقد صممت التجربة بتصميم قطاعات كاملة العشوائية وثلاث مكررات لكل معاملة وشجيرة لكل مكررة وأوضحت النتائج الاتى:

-ادت جميع المعاملات الى زيادة فى نسبة تفتح البراعم ونسبة البراعم الثمرية مع التبخير فى موعد التفتح مقارنة بالشجيرات غير المعاملة.

- ادت جميع المعاملات فى زيادة مساحة الورقة ووزن خشب التقليم مقارنة بالشجيرات غير المعاملة.

- سببت جميع المعاملات زيادة فى المحصول وتحسين خصائص العناقيد والحبات وزيادة معامل التزامم ونسبة العقد وسجلت معاملة الرش بزيت حشيشة الليمون افضل النتائج.

- لا توجد فروق معنوية بين استخدام الدورمكس وباقى المعاملات الاخرى.

ومن نتائج هذه التجربة يمكن التوصية باهمية استخدام المستخلصات النباتية خاصة زيت حشيشة الليمون كمركبات امنه لتحسين نسبة تفتح البراعم وتحسين زيادة المحصول وخصائص العنقود وحل مشكلة الشلثلة فى العنب الرومى الاحمر.