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EFFECT OF SPRAYING LIME AND SOME FUNGICIDES ON VINE GROWTH AND CONTROL OF DEAD ARM DISEASE AND BUNCH ROT OF RUBY SEEDLESS GRAPEVINES

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ABSTRACT

A field trial was conducted in 2005, 2006 and extended to January 2007 on 12-years-old Ruby Seedless grapevines trained by quadric lateral cordon and spur pruned. Vines were sprayed with lime after two weeks of berry set, $CaCl_2$ one week later, lime and $CaCl_2$ with wettable sulfur at short intervals weekly from full bloom until the fourth week after berry set. Copper oxichloride was sprayed at the fourth week of berry set mixed with the dose of wettable sulfur of this week. One concentration (3 g/L) was used from each compound. All the experimental vines were sprayed with wettable sulfur at 15 days interval from bud burst as long as temperature was lower than 28 ^oC.

Vine vigor expressed in terms of weight of pruning wood, dry weight and carbohydrate content of basal canes were improved in the second and third season of the study; carbohydrate content was improved in the second season compared to control as affected by experimental foliar spraying compounds. The best improvement occurred with spraying vines with lime (3 g/L), $CaCl_2$ and wettable sulfur (3 g/L) at short interval weekly from full bloom until fourth week of berry set. Copper oxichloride (3 g/L) was applied once mixed with the dose of wettable sulfur in the fourth week of berry set. However, this treatment significantly reduced disease severity of both dead-arm and bunch rot disease. Also, this treatment reduced the number of both dead spurs of last season seasons compared with the first and second of winter pruning of the study.

INTRODUCTION

Nutrition is considered an important factor for vine balanced growth. Regular nutrition during various stages of vine growth and fruit development is an important indicator of the nutritional health of the vines and other fruit trees. The presence of nutrient deficiency symptoms indicates an acute shortage in the plant. This may reduce yield, fruit quality and vine resistance for diseases. Soils which contain height level of potassium inhibit magnesium or calcium uptake so induce deficiencies of these element. Magnesium deficiencies may result from low soil pH or excessively high soil calcium. Dolomite lime applications are advised if pH is too low, but magnesium sulfate is preferred if soil calcium levels are excessively high (Eric, 1996). Some nutrient compounds are effective on improving nutrient status of the vines and its resistance against disease if used as foliar spaying on the vine at specified vine annual growth and development at short or long intervals such as lime (Mg, Ca, $CaCl_2$, wettable sulfur (S) as macronutrients or Copper oxichloride (Cu) as microelement. Spraying Ruby Seedless grapevines with lime (3 g/L) after two weeks of berry set followed by $CaCl_2$ (3 g/L) one week later improved grape quality, berry firmness and wood maturity (Abd Elghany, 2006). Moreover, Williams & Gohn (1996) used two dolomite liming materials $Ca(OH)_2$, $Mg(OH)_2$ or $CaCO_3$. $MgCO_3$ on impatiens with both lime type and

their was increase in tissue Ca and Mg with the applied concentrations. On the other hand, Stefanini *et al*. (1994) noted that, Mg application increased plant vigor (expressed in terms of the weight of pruning) in vines Uva di Troia cultivar. Many plant proteins contain sulfur, however, copper (Cu) utilizes protein (Weaver, 1976). Easterwood (2002) indicated that fungal pathogenic infection was reduced with increased calcium uptake by plants. A steady supply of available calcium delivered during fertigation by calcium nitrate reduces *Fusarium oxysporum* activity, the fungal pathogen that causes wilt and crown rot in tomatoes. Research indicates that tomato plants receiving low rates of calcium fertilization were severely infected with *Fusarium oxysporum*, compared to healthy plants receiving higher calcium rates. Calcium fertilization also reduces Pythium blight and root rot of turf grass and citrus. Also, Easterwood (2002) showed that increasing potassium concentration in Lettuce from 1.44 to 4.89 percent did not deter *Botrytis* infection. However, decreasing tissue calcium concentration by half from 1.06 to 0.54 percent increased infection from a slight to moderate rating. A further decrease in calcium by one-half in the tissue (0.54 to 0.22 %) resulted in severe *Botrytis* infection. Lesson to be learned : enhanced cell wall structural integrity supplied by calcium fertilization is important for plant health. (Attia & Saber, 1995) reported that during the season 1995 in El Khatatba Menofia governorate in Egypt, heavy infection was found on both primary and trifoliate leaves, stem, shoots, petioles, tendrils and fruit. (Saber, 1998) isolated *Phomopsis viticola* as causal pathogen for dead-arm disease in Egypt. (Fatma & Radwan, 1985) isolated many fungi from rotted berries of different grapevine cultivars in different locations in Egypt as *Botrytis cinerea*, *Aspergillus niger*, *Botryodeplodia theobroma*, *Alternaria alternate* and *Penicillum italicum*. The objective of this trial was to eliminate dead-arm produced on grapes and control diseases without using any toxic inorganic compounds.

MATERIALS AND METHODS

This experiment was conducted during two seasons 2005 and 2006 and extended to January 2007 on 12-year-old "Ruby Seedless" grapevines, spaced at 2 x 3 meters apart in sandy soil of a private vineyard at El-Khatatba, Menofia governorate. The vines were in normal growth, vigor and quadrilateral cordon training system with spur pruning, leaving 20 bearing units, each bearing unit contain two spurs, each spur contained two buds with the total of 80 buds/vine. For this study, 105 vines were chosen, 5 vines per treatment replicated 3 times. The complete randomized block design was used and L.S.D test was used to compare among means of treatments. The concentration used from each compound was (3 g/L). All vines were sprayed with wettable sulfur at long intervals of 15 days. The treatments were as follows : 1- spraying lime (3 g/L) after two weeks of berry set + wettable sulfur (3 g/L) weekly from full bloom until fourth week of berry set. 2- spraying $CaCl_2$ (3 g/L) after three weeks of berry set + wettable sulfur. 3- spraying lime (3 g/L) after two weeks of berry set + $CaCl_2$ (3 g/L) after tree weeks of berry set + wettable sulfur (3 g/L). 4- spraying lime (3 g/L) after two weeks of berry set + wettable sulfur (3 g/L) weekly from full bloom until four weeks after berry set

+ Copper oxichloride (3 g/L) at the fourth week of berry set mixed with wettable sulfur. 5- spraying $CaCl_2$ (3 g/L) + Wettable sulfur (3 g/L) + Copper oxichloride (3 g/L). 6- spraying lime (3 g/L) + $CaCl_2$ (3 g/L) + Wettable sulfur (3 g/L) + Copper oxichloride (3 g/L). 7- control.

One concentration (3 g/L) was used from each experimental compound. Lime was sprayed on the vines after two weeks of berry set. $CaCl_2$ was sprayed after three weeks of berry set. Wettable sulfur was sprayed at short interval weekly from full bloom until fourth week of berry set. While, Copper oxichloride was sprayed four weeks after berry set mixed with the dose of wettable sulfur of the week. All vines of this trial were sprayed with wettable sulfur at long intervals of 15 days after bud burst including control. Vine growth was investigated for the following characteristics :

a- Pruning weight kg/vine as current season shoots in January of each winter pruning of the seasons of the study.
b- Cane dry weight percentage ; samples of the basal three nodes of the canes were collected on January of the study seasons samples and cut into small pieces and fresh weight were recorded, oven dried at 70 ^oC for 72 hours, and the percentage of dry weight was calculated.
c- Cane carbohydrates percentage ; samples of basal current seasons canes (1-3 nodes) were collected on January 1st in the two seasons and determined calorimetrically at 490 mu wave length, using the phenol sulfuric acid methods described by Smith *et al*. (1956).

Disease observation :

This trial was conducted with the target to determine the efficiency of some tested chemicals in a spray program against dead-arm disease and bunchy rot disease.

Dead-arm disease assessment : The dead-arm disease evaluated on 20 canes and shoots of each replication as the following :

0- No symptoms.
1- Shoots with 1-2 spots per internode.
2- Shoots with 3-5 spots per internode.
3- Shoots with 5-10 spots per internode.
4- Shoots with up to 10 spots per internode.

The disease severity (DS) was calculated according to the formula described by (Abo-Rehab, 2002) as follows : Disease severity (%) = ($\sum$(n x v)/N x V) 100, where, n= No. of shoots at rate v (disease score), N = total no. of shoots investigated and V = highest disease severity rate.

Bunch rot disease assessment :

The bunch rot disease was evaluated on the bunches according to the following scale using 30 bunches for each replicate.

0- No symptoms.
1- 1-10 % infection on the bunch.
2- Up to 20 % infection on the bunch. The disease severity (DS) was calculated according to the following formula : Disease severity (%) = ($\sum$ (n x v)/ N x V) 100, where, n= No. of bunches at rate v (disease score), N = total no. of bunches investigated and V = highest disease severity rate dead spurs of the last season of lower spur and upper spur on the bearing units were recorded during winter pruning

(January) as number per vine. Isolated of causal pathogen and confirm its pathogenicity carried out as the method described by Saber, (1998). For dead-arm disease and (Fatma Radwan, 1985) for bunch rot.

RESULTS AND DISCUSSION

Many characteristics are considered as indicators to vine growth such as pruning weight of current season shoots in the winter pruning per vine, dry weight of canes percentage and carbohydrate content of canes.

Data in Table (1) show that, foliar spraying Ruby seedless grapevines with lime, $CaCl_2$, lime and $CaCl_2$, with wettable sulfur or and copper oxichloride gave pronounced increase in pruning weight in the second and third seasons but not in the first one. The best increments in the second and third season resulted from spraying vines with lime and $CaCl_2$ and wettable sulfur or and oxichloride. The results of the first season may be due to the absence of treatments effect, but the results of second and third season are in harmony with Abd Elghany (2006). He noticed that foliar spraying of Ruby seedless with lime (3 g/L) two weeks after fruit set and $CaCl_2$ (3 g/L) three weeks later significantly increased pruning weight per vine compared to control. However, Marwad *et al*. (2001) noted that sprayed vines of Thompson seedless with calcium at full bloom and three weeks later increased pruning weight. Moreover, Stefanini *et al*. (1994) recorded that, application of magnesium increased plant vigor expressed in terms of the weight of pruning in Uva di Troig vines.

Table (1): Effect of lime, $CaCl_2$ and wettable sulfur or and copper oxichloride on pruning weight, dry weight of canes and carbohydrate content of Ruby Seedless grapevines in 2005, 2006 and 2007 seasons.

Treatment	Pruning weight (kg/vine)			Dry weight of basal cane (1-3 nodes) %			Basal cane carbohydrate %	
	2005	2006	2007	2005	2006	2007	2005	2006
Lime + wettable sulfur	0.8	1.1	0.93	46	48	47	13.2	13.6
$CaCl_2$ + wettable sulfur	0.8	1.1	0.97	45	47	47	13.1	13.9
Lime + $CaCl_2$ + wettable sulfur	0.8	1.2	1.17	46	48	48	13.4	14.2
Lime + wettable sulfur + copper oxichloride	0.9	1.1	1.0	45	47	47	13.1	13.6
$CaCl_2$ + wettable sulfur + copper oxichloride	0.9	1.1	1.03	46	47	48	13.3	13.8
Lime + $CaCl_2$ + wettable sulfur + copper oxichloride	0.8	1.2	1.27	46	49	49	13.3	14.4
Control	0.9	0.8	0.77	46	45	45	13.4	12.6
L.S.D at 5 %	**Pruning weight**			**Dry weight of basal cane**			**Basal cane carbohydrates**	
	L.S.D $_{0.05}$ T: 0.09			**L.S.D $_{0.05}$ T: 0.83**			**L.S.D $_{0.05}$ T: 0.43**	
	L.S.D $_{0.05}$ Y: 0.06			**L.S.D $_{0.05}$ Y: 0.55**			**L.S.D $_{0.05}$ Y: 0.23**	
	L.S.D $_{0.05}$ Y*T: 0.15			**L.S.D $_{0.05}$ Y*T: 1.44**			**L.S.D $_{0.05}$Y*T:0.61**	

Regarding dry weight percentage of basal shoots (1-3 nodes), data in Table (1) show that, foliar spraying of Ruby seedless grapevine with lime (3

g/L) after two weeks of berry set or $CaCl_2$ (3 g/L) after three weeks of berry set or both lime and $CaCl_2$ with wettable sulfur (3 g/L) at weekly intervals from full bloom until fourth week of berry set mixed with the dose of wettable sulfur of the week improved dry weight significantly in the second and third season of the study, but not in the first season. The best improvement was recorded with treatment of lime followed by $CaCl_2$ with wettable sulfur or and copper oxichloride. The increase of basal cane dry weight may be due to the role of calcium as a constituent of the middle lamella of cell walls, which favors translocation of amino acids and carbohydrates. Moreover, many plant proteins contain sulfur and copper (Weaver, 1976). Concerning carbohydrate content of basal cane (1-3 nodes) of Ruby seedless grapevines, data in Table (1) show that, foliar spraying of lime after two weeks of berry set with wettable sulfur or $CaCl_2$ after three weeks of berry set with wettable sulfur or and copper oxichloride in the fourth week of berry set improved cane carbohydrates percentage in the second season compared to control. The best increment occurred with spraying the vines with lime followed by $CaCl_2$ with wettable sulfur or and copper oxichloride.

Table (2): Effect of lime, $CaCl_2$ and wettable sulfur or and copper oxichloride on the number of last season dead spurs of Ruby Seedless grapevines in 2005, 2006 and 2007 seasons.

Treatment	Lower dead spurs No/vine			Upper dead spurs No/vine		
	2005	2006	2007	2005	2006	2007
Lime + wettable sulfur	4.3	2.7	2.3	3.0	1.3	1.7
$CaCl_2$ + wettable sulfur	3.3	2.3	2.7	2.7	1.3	1.7
Lime + $CaCl_2$ + wettable sulfur	3.7	2.3	2.0	3.0	1.3	1.3
Lime + wettable sulfur + copper oxichloride	3.3	2.7	2.0	3.0	1.3	1.3
$CaCl_2$ + wettable sulfur + copper oxichloride	3.3	1.3	1.7	3.0	1.0	1.3
Lime + $CaCl_2$ + wettable sulfur + copper oxichloride	3.0	1.3	1.3	3.0	1.0	1.3
Control	4.3	3.7	3.3	3.3	2.0	3.0
L.S.D at 5 %	**Lower dead spurs**			**Upper dead spurs**		
	L.S.D $_{0.05}$ T: 0.88			**L.S.D $_{0.05}$ T: 0.73**		
	L.S.D $_{0.05}$ Y: 0.58			**L.S.D $_{0.05}$ Y: 0.48**		
	L.S.D $_{0.05}$ Y*T: 1.5			**L.S.D $_{0.05}$ Y*T: 1.3**		

Data in Table (2) show that spraying Ruby seedless grapevines with lime, $CaCl_2$, lime and $CaCl_2$ with wettable sulfur or and copper oxichloride reduced number of dead spurs. The reduction was noted in both lower and upper spurs of the last season compared to control. The reduction was more pronounced with vine foliar spraying of lime and $CaCl_2$ with wettable sulfur or and copper oxichloride in the second and third seasons of the trial. While in the first season the differences among the treatments were not significant. These results of the first season may be due to that the effect of treatments was absent. While the reduction in number of dead old spurs of the second

and third seasons may be due to the improvement of the vine nutrition. From this trial it could be concluded that if nutrition program of Ruby seedless grapevines include spraying vines with lime (3 g/L) after two weeks of berry set followed by $CaCl_2$ (3 g/L) one week later and wettable sulfur (3 g/L) weekly from full bloom until fourth week of berry set and copper oxichloride (3 g/L) mixed with the dose of wettable sulfur of this week can improve vine growth, increase weight of wood pruning, dry weight and carbohydrate content of basal canes and moreover reduced old dead spurs on the vines.

Different fungi were detected and isolated from various vine parts including; basal shoots, dead spurs and grape bunches. Both basal shoots and dead spurs carry the fungus *Phomopsis viticola*, while the bunches carry *Botrytis cinerea*, *Aspergillus niger* and *Pencillium italicum*.

Results in Table (3) are in harmony with (Saber, 1998), (Abo-Rehab, 2002), (Rashed, 2006), (Fatma Radwan, 1985).

Table (3) : Isolated fungi from diseased plants :

Part of plant	Isolated fungi and its ability to pathogenicity
Basal shoots	*Phomopsis viticola (+), Alternaria sp (-).*
Dead spurs	*Phomopsis viticola (+)*
Bunches	*Botrytis cinerea (+), Aspergillus niger (+), Penicillium italicum*

Data in Table (4) show that spraying Ruby seedless grapevines with lime, $CaCl_2$, lime and $CaCl_2$ with wettable sulfur or and copper oxichloride reduced disease severity of dead-arm and bunch rot especially in the last season. These results may be due to increasing calcium content of cell wall by applying this element in the nutrition program and the actions of copper and sulfur as fungicides. Easterwood (2002) indicated that many fungi and bacteria invade and infect plant tissue by producing enzymes that dissolve the middle lamella. Enzymes responsible for dissolving the middle lamella include polyglacturonases and pectolytic enzymes such as pectate transeliminase. The same author also showed that increasing potassium concentration in lettuce from 1.44 to 4.89 percent did not deter *Botrytis* infection. However, decreasing tissue calcium concentration by half from 1.06 to 0.54 percent increased infection from a slight to moderate rating. A further decrease in calcium by one-half in the tissue (0.54 to 0.22 %) resulted in severe *Botrytis* infection. Lesson to be learned: enhanced cell wall structural integrity supplied by calcium fertilization is important for plant health. Increasing tissue calcium content astonishingly lowers polyglacturonase and petolytic enzyme activity. Calcium as a part of cell wall also regulates transport of other nutrients into the plant calcium deficiency results in stunting. Cell wall strength and thickness are increased by calcium addition. Calcium is a critical part of the cell wall that produces strong structural rigidity by forming cross-links within the pectin polysaccharide matrix. With rapid plant growth, the structural integrity of stems that hold flowers and fruit, as well as the quality of the fruit produced, is strongly coupled to calcium availability. On the other hand, copper is important for photosynthesis. Symptoms for copper deficiency include chlorosis.

Table (4) : Effect of lime, $CaCl_2$ and wettable sulfur or and copper oxichloride on the disease severity of dead-arm disease and bunch rot disease of Ruby seedless grapevines in 2005 and 2006 seasons.

Treatment	Dead-arm Disease severity %		Bunch rot Disease severity %	
	2005	2006	2005	2006
Lime + wettable sulfur	3.2	2.1	4.5	3.9
$CaCl_2$ + wettable sulfur	2.9	1.3	3.3	2.9
Lime + $CaCl_2$ + wettable sulfur	2.7	1.6	3.1	2.4
Lime + wettable sulfur + copper oxichloride	3.0	1.9	4.1	3.5
$CaCl_2$ + wettable sulfur + copper oxichloride	2.1	0.0	2.9	0.0
Lime + $CaCl_2$ + wettable sulfur + copper oxichloride	1.3	0.0	2.6	0.0
Control	4.5	4.1	6.4	6.3
L.S.D at 5 %	**Dead-arm Disease severity %**		**Bunch rot Disease severity %**	
	$L.S.D_{0.05}$ T: 0.72		**$L.S.D_{0.05}$ T: 0.21**	
	$L.S.D_{0.05}$ Y: 0.38		**$L.S.D_{0.05}$ Y: 0.11**	
	$L.S.D_{0.05}$ Y*T: 1.02		**$L.S.D_{0.05}$ Y*T: 0.30**	

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تأثير الرش بالكالسيوم والجير والكبريت الميكرونى وأوكسى كلورو النحاس على نمو كروم العنب الروبى اللابذرى ومقاومتها لمرضى موت الذراع وأعفان الثمار

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*** معهد بحوث البساتين - مركز البحوث الزراعية – الجيزة – مصر**

***معهد بحوث أمراض النبات - مركز البحوث الزراعية – الجيزة – مصر**

فى تجربة على عنب روبى لابذرى عمر ١٢ عام منزرع فى أرض رملية بالخطاطبة بمحافظة المنوفية مرباة كردون رباعى والتقليم دابرى وحدات ثمرية ٢ دابرة كل دابرة ٢ عين ٨٠ عين لكل كرمة وقد تم تطبيق البرنامج الآتى على هذه الكروم :

المعاملة الأولى : تم رش الجير مع كبريت ميكرونى.

المعاملة الثانية : تم رش كلوريد الكالسيوم مع كبريت ميكرونى.

المعاملة الثالثة : تم رش الجير مع كلوريد الكالسيوم مع كبريت ميكرونى أسبوعياً من التزهير الكامل حتى الأسبوع الرابع من العقد.

المعاملة الرابعة : تم رش الجير مع كبريت الميكرونى مع أوكسى كلور النحاس.

المعاملة الخامسة : تم رش كلوريد الكالسيوم مع كبريت ميكرونى مع أوكسى كلور النحاس فى الأسبوع الرابع من العقد.

المعاملة السادسة : تم رش الجير وكلوريد الكالسيوم مع كبريت ميكرونى مع أوكسى كلور النحاس.

المعاملة السابعة : تم الرش بالكبريت الميكرونى فقط مع إنتفاخ البراعم وعلى فترات كل ١٥ يوم (كنترول).

استخدم تركيز واحد لكل مركب (٣ جم/لتر) وتم رش هذه المركبات فى التوقيتات الآتية :

الجير تم الرش بعد العقد بأسبوعين و كلوريد الكالسيوم بعد العقد بثلاث أسابيع وأما الكبريت الميكرونى فقد تم رشة على فترات قصيرة أسبوعياً من الإزهار الكامل حتى الأسبوع الرابع من العقد وكذلك أوكسى كلور النحاس تم رشه مرة واحدة مخلوطاً مع جرعة نفس الأسبوع من الكبريت الميكرونى فى الأسبوع الرابع من العقد.

أظهرت المعاملات تحسناً فى نمو الكروم مقاساً بوزن أفرع الموسم السابق لكل كرمة (خشب التقليم) فى الموسم الثانى والثالث للتجربة وأظهرت نتائج الوزن الجاف لقواعد الأفرع (١-٣ عقدة) نفس السلوك ، وأظهر محتوى قواعد الأفرع من الكربوهيدرات سلوكاً مشابهاً لذلك فى الموسم الثانى وكانت أفضل النتائج مع المعاملة بالجير متبوعاً بكلوريد الكالسيوم بعد أسبوع من الرش بالكبريت الميكرونى أسبوعياً من التزهير الكامل حتى الأسبوع الرابع مع أوكسى كلور النحاس والكبريت الميكرونى كما أظهرت هذه المعاملة نقصاً واضحاً لعدد دوابر الموسم الماضى الجافة لكل كرمة أثناء التقليم فى الموسم الثانى والثالث للتجربة بينما لم يكن هناك فروق فى الموسم الأول. وكذلك أظهرت هذه المعاملات فروقاً معنوية فى تقليل شدة الإصابة بكلاً من مرضى موت الذراع فى العنب المتسبب عن الفطر *Phomopsis viticola* و أعفان ثمار العنب المتسببة عن الفطريات *Botrytis cinerea*, *Aspergillus niger*, *Pencillium italicum*.

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