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USE OF SINGLE AND DOUBLE TRUNK IN TRAINING OF CONCORD SEEDLESS AND SUPERIOR SEEDLESS GRAPEVINES

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ABSTRACT

A field experiment was conducted during 2004 and 2005 growing seasons in a private farm at Wadi El-Natroun, Behera Governorate, Egypt to study the effect of using single and double trunk on vine yield and quality of Concord and Superior Seedless grapes under drip irrigation system and sandy soil conditions of Nubaria region. A separate trial was performed for each cultivar.

The results showed superiority of using the double trunk system over the single trunk since it had higher percentages of bud burst and fruitful buds per vine, bud fertility and higher values of old wood size.

There is a significant yield increase, in favour of the double trunk (DT) as compared to that of the single trunk (ST). Also, average weight prunings revealed significant increase for the DT system over that of the ST system. Both treatments had no significant effect on physical and chemical fruit parameters. The results were nearly similar to those of both cultivars with regard to these estimates.

From this study it could be concluded that, for high production of Concord and Superior grapevines in the sandy soil of Nubaria region the use of double trunk in the training system is recommended.

INTRODUCTION

Cawthon & Morris (1977) tested the effect of pruning severity, nodes per bearing unit, training system, shoot positioning and sampling date on yield and quality of "Concord" grapes. Their results indicated that the yield was positively correlated to the number of buds/vine and negatively with grape quality. They showed that with pruning to 6 or 9 nodes, the yield was higher than with pruning to 3 nodes.

Morris & Cawthon (1977) conducted a study to investigate the interrelationship between pruning severities, nodes/bearing unit, two cordon training systems and shoot positioning on yield and quality of "Concord" grapes. They reported that the number of nodes/bearing unit had no effect on soluble solids, acidity, color, or % green fruit/cluster; even though there was a considerable yield increase occurred when vines were pruned to longer canes.

Again Morris & Cawthon (1980) stated that the Geneva Double Curtain (GDC) training system allows better distribution of fruiting canes, reduces shading of shoots, and produces higher yields on vigorous vines than Umbrella Knifing (UK) or Single Curtain (SC) training systems.

Wolpert *et al* (1983) investigated training system, pruning severity and several vine canopy conditions for their effects on cluster weight and juice quality. Results showed that training system had no major effect on the measured parameters. Decreasing pruning severity resulted in decreased

soluble solids of juice. Exposure of shoots to sunlight resulted in higher soluble solids and lower acidity in all cases.

Morris *et al* (1985) compared the effect of bilateral cordon (BC) and GDC training systems on the yield and quality of Concord grapes. They showed that GDC trained vines produced higher yields than the BC trained ones. They indicated also that the training system had little effect on juice quality of berries.

Koblet *et al* (1994) tested the effect of leaf removal, rootstock and training system on yield and fruit composition of Pinot noir grapevines. They stated that fruit yield showed a clear positive relationship with trunk volume.

Baeza *et al* (2005) compared four grapevine training systems (single curtain, vertical shoot-positioned, high bush, and short bus) for their effects on physiological performance, yield, vegetative growth, and must composition in *Vitis vinifera* L. cv. Tempranillo in Mediterranean weather conditions. They concluded that the vertical shoot-positioned system was most productive. Single curtain and high bush had greater total soluble solids at the expense of lower grape yield.

It is worthmentioning that no researches dealing with the use of single and double trunk in the training systems are available in Egypt. The idea of carrying out such a research was based only on personal observations on the work of some foreign experts in some vineyards in Egypt where single and double trunks were used on Flame Seedless grapevines trained to the quadrilateral cordon systems.

The objective of this study was to test the effect of using single and double trunks on the productivity of Concord and Superior seedless grapevines under drip irrigation system in the sandy soil of Nubaria region.

MATERIALS AND METHODS

The present investigation was carried out in a private farm located at Wadi El-Natroun, Behera Governorate, Egypt during the 2004 and 2005 seasons. Two separate trails were conducted to evaluate the effect of this technique on yield and fruit quality of Concord Seedless and Superior Seedless grapevines.

Own-rooted Concord seedless grapevines were planted in 2000. The vines were supported to the Gable system. Planting distances were 2m between the vines in the row and 3m between rows. Uniform vines were chosen for both treatments.

It is worthmentioning that the following parameters were determined at the end of this research work for offering data which may be useful for the interpretation of some results in this investigation.

Bud behaviour : During the spring, number of bursted buds and number of fruitful buds were counted. Then, percentages of these values and the average number of clusters per vine were calculated.

Bud fertility : Coefficient of bud fertility per vine was calculated by dividing average number of clusters per vine by number of buds per vine as mentioned by Huglin (1958).

$$\text{Bud burst \%} = \frac{\text{Number of bursted buds per vine}}{\text{Total number of buds per vine}} \times 100$$

$$\text{Fruitful buds \%} = \frac{\text{Number of fruitful buds per vine}}{\text{Total number of buds per vine}} \times 100$$

$$\text{Bud fertility coefficient} = \frac{\text{Number of fruitful buds per vine}}{\text{Total number of buds per vine}} \times 100$$

Size of old wood : It was determined for all above ground parts of the vine which included trunk and all units of more than year old.

Circumference and length of these units were measured and the total size of old wood was then calculated according to the following equation by Hassan *et al* (1991).

$S = \pi \times D^2 \times L$

Where:

S : is the total size of old wood

π : is a constant which equals 3.14

D : is the diameter of the measured part

L : is the length of the measured part

At harvest time, the following data were recorded:

Yield (kg/vine), cluster weight (g), weight of 100 berries (g), juice weight and volume of 100 berries (ml), berry dimensions and weight of prunings (kg/vine). Total soluble solids (TSS) and acidity of the berries were determined according to the methods given by A.O.A.C. (1960). TSS/acidity ratio was calculated. Anthocyanin values at O.D. 530mm were also determined according to Hisa *et al* (1965).

The randomized complete blocks design (RCBD) with three replicates was used in this experiment. Each replicate consisted of five vines. The obtained data were statistically analyzed using the analysis of variance (ANOVA). The Duncan's Multiple Range Test was used for comparing between means as suggested by Steel and Torrie (1980).

The tested treatments were as follows:

A- Concord seedless grapevines:
   1- Single Trunk (ST): with 8 canes of 10 buds each.
   2- Double Trunk (DT): with 12 canes of 10 buds each.

B- Superior grapevines:
   1- Single Trunk (ST): with 8 canes of 12 buds each.
   2- Double Trunk (DT): with 12 canes of 12 buds each

RESULTS AND DISCUSSION

1- Concord Seedless:

1.1. Bud behaviour and size of old wood:

Data presented in Table (1) clearly reveal the superiority of using the double trunk system over the single trunk since it had higher percentages of bud burst and fruitful buds per vine, bud fertility and higher values of old wood size.

Table 1. Effect of the use of single or double trunk on bud behaviour and size of old wood of Concord Seedless grapevines during 2005 season.

treatment	Bud burst %	Fruitful buds %	Bud fertility coefficient	Size of old wood (dcm^3)
Single Trunk (ST)	54.67 b	46.07 b	0.73 b	1.61 b
Double Trunk (DT)	62.00 a	51.50 a	0.88 a	2.57 a

1.2. yield per vine:

The effect of treatments on average yield (kg/vine), average cluster eight (g) and pruning weight (kg/vine) during both 2004 and 2005 seasons is presented in Table (2). The results showed a significant effect of the tested treatments on the obtained yield for both growing seasons. The yields were 11.0 and 10.96 kg/vine for the DT treatment in the 1st and 2nd seasons, respectively. For the ST treatment, the obtained yields were 9.2 and 8.73 kg/vine for the two seasons respectively. It can also be shown that there was no significant effect of the both treatments on cluster weight. The results of this investigation are in line with those reported by Morris and Cawthon (1980) and Morris et al. (1985).

Average weight of prunings (kg/vine) for the double trunk treatment was significantly higher than that of the single trunk treatment in both seasons. Both treatments had a slight effect on the other tested parameters. In general, the values for double trunk treatment were higher than use for the single trunk treatment.

Table 2. Effect of the use of single or double trunk on yield (kg/vine), average cluster weight (g) and weight of prunings (kg/vine) of Concord Seedless grapevines during 2004 and 2005 seasons.

Treatment	Yield (kg/vine)		Cluster weight (g)		Weight of prunings (kg/vine)	
	2004	2005	2004	2005	2004	2005
Single Trunk (ST)	9.20 b	8.73 b	244.66 a	250.00 a	3.20 b	3.33 b
Double Trunk (DT)	11.00 a	10.96 a	244.00 a	249.66 a	4.50 a	4.60 a

1.3. Physical characteristic of clusters and berries:

Effect of both treatments on cluster length (cm), cluster width (cm), berry diameter (mm), weight and size of 100 berries (g), size of 100 berries (ml), juice volume (ml), and juice weight (g) for Concord Seedless grapevines during 2004 and 2005 seasons is presented in Table 3. The results revealed no significant effect of both treatments on all fruit physical parameters.

1.4. Chemical characteristic of berries:

Effect of treatments on TSS (%), acidity (mg/100 ml juice), TSS/acidity ratio, and anthocyanin content of berry juice for Concord Seedless grapevines during 2004 and 2005 seasons are shown in Table 4. It is clear from the results that the tested treatments had no significant effect on chemical characteristic of Concord grapes. The results also indicated that total soluble solids (TSS%) for the single trunk treatment was higher than that of the double trunk treatment. Acidity of berry juice, TSS/acidity ratio, and anthocyanin parameters for the ST treatment were slightly higher than those

for DT treatment. The obtained results are in agreement with those reported by Wolpert et al. (1983), Morris et al. (1985), and Baeza et al. (2005).

Table 3. Effect of the use of single or double trunk on some physical characteristics of Concord Seedless grapes during 2004 and 2005 seasons.

Treatment	Cluster length (cm)		Cluster width (cm)		Berry diameter (cm)		Weight of 100 berries (g)	
	2004	2005	2004	2005	2004	2005	2004	2005
ST	16.10a	15.76a	11.0a	10.86a	1.48a	1.48a	221.7a	197.7a
DT	16.26a	16.13a	10.8a	11.03a	1.53a	1.51a	223.7a	201.7a
Treatment	Size of 100 berries (ml)		Juice volume (ml)		Juice weight (g)			
	2004	2005	2004	2005	2004	2005		
ST	197.7a	172.3a	159.0a	143.0a	150.0a	138.7a		
DT	197.0a	178.3a	157.a	146.7a	149.7a	140.0a		

Table 4. Effect of single and double trunk application characteristic on some chemical characteristics of Concord Seedless grapes during 2004 and 2005 seasons.

Treatment	TSS (%)		Acidity (mg/ 100 ml juice)		(TSS/Acidity)		Anthocyanin (mg/ 100 g of berry skin)	
	2004	2005	2004	2005	2004	2005	2004	2005
ST	18.43a	18.6a	0.606a	0.62a	30.36a	29.86a	0.232a	0.237a
DT	18.26a	18.3a	0.600a	0.61a	30.23a	29.53a	0.213a	0.229a

2- Superior Seedless grapevines:

2.1. Bud behaviour and size of old wood:

Data presented in Table (5) clearly reveal the superiority of using the double trunk system over the single trunk since it had higher percentages of bud burst and fruitful buds per vine, bud fertility and higher values of old wood size.

Table 5. Effect of the use of single or double trunk on bud behaviour and size of old wood of Superior Seedless grapevines during 2005 season.

Treatment	Bud burst %	Fruitful buds %	Bud fertility coefficient	Size of old wood (dcm^3)
	2005	2005	2005	2005
Single Trunk (ST)	64.66 b	43.33 b	0.54 b	6.27 b
Double Trunk (DT)	71.66 a	51.00 a	0.64 a	9.08 a

2.2. yield per vine:

The effect of treatments on the average yield (kg/vine), average cluster weight (g) and pruning weight (kg/vine) during the 2004 and 2005 seasons is presented in Table 6. Results showed that yield for the double trunk treatment was significantly higher than that obtained from the single trunk. Vines trained to DT system produced more than those trained to ST system. This yield increase could be due to retaining more canes (12) under DT treatment as compared to 8 canes under the ST treatment. Results showed also that, there were no significant differences between treatments concerning average cluster weight.

Average weight of prunings for the double trunk treatment was significantly higher than that obtained from the single trunk.

Table 6. Effect of the use of single or double trunk on yield (kg/vine), average cluster weight (g) and weight of prunings (kg/vine) of Superior Seedless grapevines during 2004 and 2005 seasons.

Treatment	Yield (kg/vine)		Cluster weight (g)		Weight of prunings (kg/vine)	
	2004	2005	2004	2005	2004	2005
Single Trunk (ST)	9.73 b	10.10 b	506.0 a	520.0 a	4.10 b	4.26 b
Double Trunks (DT)	12.5 a	12.83 a	495.0 a	508.3 a	6.00 a	6.20 a

2.3. Physical characteristic of clusters and berries:

Effect of both treatments on cluster length (cm), cluster width (cm), berry diameter (mm), weight and size of 100 berries (g), size of 100 berries (ml), juice volume (ml), and juice weight (g) for Superior Seedless grapevines during 2004 and 2005 seasons is presented in Table 7. The results revealed no significant effect of both treatments on all fruit physical parameters.

Table 7. Effect of the use of single or double trunk on some physical characteristics of Superior Seedless grapes during 2004 and 2005 seasons.

Treatment	Cluster length (cm)		Cluster width (cm)		Berry diameter (mm)		Weight 100 berries (g)	
	2004	2005	2004	2005	2004	2005	2004	2005
ST	20.0a	21.3a	13.9a	13.4a	2.05a	2.07a	470.0a	479.3a
DT	19.0a	20.8a	13.7b	13.8a	2.08a	2.05a	480.0a	473.3a
Treatment	Size 100 berries (ml)		Juice volume (ml)		Juice weight (g)			
	2004	2005	2004	2005	2004	2005		
ST	426.7a	426.7a	398.3a	406.7a	378.3a	383.3a		
DT	433.3a	425.0a	391.7a	396.0a	368.3a	380.0a		

2.4. Chemical characteristic of berries:

Effect of the treatments on TSS (%), acidity (mg/100 ml juice) and TSS/acidity ratio for Superior seedless grapes during 2004 and 2005 seasons is shown in Table 8. It is obvious from the results that there was no significant difference between single and double trunk treatments on the measured TSS, acidity and TSS/acidity ratio parameters. Average TSS and TSS/acidity values for the ST treatment were slightly higher than those for the DT treatment.

Table 8. Effect of single and double trunk application characteristic on some chemical characteristics of Superior Seedless grapes during 2004 and 2005 seasons.

Treatment	TSS (%)		Acidity (mg/ 100 ml juice)		(TSS/Acidity)	
	2004	2005	2004	2005	2004	2005
ST	19.17a	19.73a	0.71a	0.63a	25.76a	29.23a
DT	19.00a	19.67a	0.73a	0.69a	25.56a	28.83a

As already mentioned before, the results clearly revealed the superiority of applying the double trunk in the process of vine training over single trunk in many aspects such as the yield per vine, cluster and berry weight and berry dimensions in both studied cultivars. The possible interpretations of these results may find their way through the following considerations:

1) The double trunk system was shown to have higher percentages of fruitful buds, higher bud fertility coefficient and higher values of old wood size as compared to the single trunk system (Table, 1).
2) It is well-known that old wood size is not merely a structural element of the vine but also a reservoir for assimilates and mineral salts during the growing season. These substances improve the nutritional status of the vine productivity (Hassan *et al* 1991).
3) The possibility of increasing vine load in the double trunk system as compared to the single trunk. This by its turn results in a higher yield per vine.

From the obtained results it can be recommended to apply the double trunk (DT) system either for Concord Seedless or Superior Seedless grapevines.

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تأثير إستخدام ساق مفرد أو مزدوج فى تربية أشجار العنب صنفى الكونكورد اللابذرى والسوبيريور اللابذرى

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اجريت تجربة حقلية في موسمي النمو ٢٠٠٤ و ٢٠٠٥ بإحدي المزارع الخاصة بمنطقة وادي النطرون – محافظة البحيرة – جمهورية مصر العربية لدراسة تأثير نظامين لتربية العنب (كرمة ذات جذعين ، كرمة ذات جذع واحد) علي الناتج المحصولي والصفات الطبيعية والكيميائية للثمار لصنفي عنب الكونكورد والسوبيريور تحت نظام الري بالتنقيط في الأراضي الرملية لمنطقة النوبارية. ويمكن تلخيص أهم نتائج الدراسة فيما يلي:

تفوق إستخدام كرمة ذات جذعين عن إستخدام كرمة ذات جذع واحد حيث أنها أعطت أفضل نسبة مئوية للبراعم المتفتحة والبراعم الثمرية لكل كرمة وأعلى قيمة لمعامل الخصوبة وحجم الخشب القديم.

كانت هناك زيادة معنوية فى المحصول ووزن القصاصة للنموات الناضجة عمر سنة لمعاملة الكرمة ذات جذعين بالمقارنة بالمحصول ووزن القصاصة لقصبات عمر سنة لمعاملة الكرمة ذات الجذع الواحد في كلا الموسمين. كما لم يوجد فرق معنوي بين نظامي التربية فيما يتعلق بالخصائص الطبيعية والكيميائية للعناقيد والحبات.النتائج كانت متشابهة إلى حد كبير فى كلا الصنفين معا.

ومن نتائج هذه الدراسة يمكن التوصية باستخدام طريقة التربية "كرمة ذات جذعين" للحصول علي أعلي انتاجية لصنفي العنب كونكورد اللابذرى و السوبيريور اللابذرى في الأراضي الرملية بمنطقة النوبارية.