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INFLUENCE OF DIFFERENT FRUITING SHOOTS RATIOS ON PRODUCTIVITY ATTRIBUTES AND FRUIT QUALITY OF RUBY SEEDLESS GRAPEVINES IN THE CURRENT AND FOLLOWING SEASONS

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ABSTRACT

Field experiment was conducted during 2007/2008 and 2008/2009 seasons on 7-years old grapevines cv. Ruby Seedless grown in clay soil located at Dakahlia governorate, Egypt and irrigated by drip irrigation system. Vines were spaced at 2.5 x 3 meters apart, pruned during the first week of January. A bilateral cordon was used as a training system with 40 buds / vine. Treatments were imposed on different vines in both years, and follow up the residue effects in the next season on bud behavior, yield weight and fruit quality. Seventy five vines were used and divided into five groups (fifteen each) according to fruiting shoots ratio to reach the best ratio between fruiting and vegetative shoots to achieve not only maximum productivity with high fruit quality in the current season but also in the following season as well.

The content of chlorophyll a and b and petiole composition increased in vines with low fruiting shoots. The vines with 2:1, 3:1 and 4:1 ratios had the highest leaf area per vine, leaves number per shoot with lowest leaf area per kg fruit weight. 3:1 ratio had the highest ratio of shoot density, coefficient of wood ripening, total carbohydrates, pruning weight and crop load. Cluster physical characteristics were decreased by increasing the fruit shoots ratio after 3:1 ratio. Vines with 2:1 ratio gave the highest compactness coefficient and berries number. Berry set % was decreased by increasing the fruiting shoots ratio. Berry length and diameter were increased with 1:1 and 2:1 ratios. 3 fruiting: 1 vegetative shoots caused the heaviest berry weight. All treatments significantly increased bud fruitfulness, fruitful bud %, bud fertility coefficient compared with the lowest ratio of fruiting shoots. Whereas, vegetative buds % was decreased by increasing the fruiting shoots ratio. 3:1 ratio gave the highest yield weight, and then decreased by increasing the fruiting shoots ratio. The variable of fruiting shoots ratio significantly influenced on bud behavior in the following season. Bud burst % and vegetative buds were significantly reduced with increasing the fruit shoots ratio. Vines with 4 fruiting shoots: 1 vegetative gave the highest bud fertility coefficient, and 5:1 ratio gave the highest bud fruitfulness. Cluster weight was decreased in the following season for all treatments. Yield weight was increased for vines with 1:1 and 2:1 ratio in the following season, while stayed consistence for vines with 3:1 ratio, and declined for vines with high ratio of fruiting shoots. Vines with 3:1 ratio produced the highest TSS % and TSS/ acid ratio but the lowest total anthocyanins.1:1 ratio produced the highest total acidity and total anthocyanins in berry skins and hasten ripening. In the following season.1:1 ratio produced the highest fruit quality.

INTRODUCTION

The adjustment of the optimum crop load in order to achieve expected fruit quality is still the most discussed viticulture matter. It is difficult to propose proper number of

Fruiting shoots for Ruby Seedless grapevines, especially with high number of fruiting shoots. Therefore permanent necessity for such investigation is always present. It is also widely believed by the vine growers that high-yielding vines produce lower fruit quality

In recent years the competition from Perlette, Flame, and Thompson Seedless grapes has increased demand for high quality of Ruby Seedless berry. With the introduction of Crimson Seedless, a late, fall seedless table grape with good clusters, the pressure for Ruby Seedless growers to produce clusters with high quality has increased. The efforts have successfully increased berry size, but along with bigger berries have come problems with bunch rot, poor fruit color, berry shatter at harvest, and smaller and fewer clusters in the following year. Numerous cultural practices affect berry development and fruit quality. Light interception depends on leaf area and the distribution of the leaves as affected by the shape of the plant (Smart et al., 1985).Some data suggests that an increase in leaf area or light interception could improve fruit quality in grape. Defoliation can also affect berry composition; low light from veraison to harvest reduces berry weight and TSS, and increases total acidity (Kliewer, 1971). However, direct exposure to sun can lead to high temperatures which can reduce berry weight (Kliewer, 1971), delay sugar accumulation (Kliewer and Weaver, 1971) or slow colour development (Bergqvist et al., 2001). Cluster or berry removal can stabilize vine yields and improve quality. Cluster thinning around bloom increases the weight of remaining clusters (Bravdo et al., 1984). Thinning immediately after shatter could increase berry weight and TSS (Kaps and Cahoon, 1989).

There is an optimum leaf area: fruit weight ratio for quality and early ripening of table grapes. Usually, between 7 to 15 cm^2 of leaf area is optimal for ripening I g of table grapes, despite differences in cultivar, climate and cultural practices (Kingston and van Epenhuijsen,1992). If the leaf area retained per bunch is below the optimum value, berry weight and soluble solid level decrease and the time taken to reach maturity increases (Kliewer, 1970; Kliewer and Antcliff, 1970; Kliewer and Weaver, 1971). May et al. (1969) found reductions in bud burst, fruitfulness and cluster number per node, were directly related to the severity of defoliation in the previous season. Fruit yields per vine were also reduced. Over cropping vines, have the same effect. Weaver and McCune (1960) report reduced shoots and cluster numbers, and therefore yield, in the year following over-cropping. In addition, entering dormancy with less carbohydrate in all vine parts .In this situation, poor bud burst, as well as lower cluster numbers and quality, would be expected in the following season.

Adjustment of crop load can be done by means of pruning severity, shoots thinning early in the season and cluster thinning (Reynolds, 1989; Schalkwyk et al., 1995; Palliotti and Cartechini, 2000). The influence of different crop loads on grape quality for different cultivars and different growing regions has been extensively described and reviewed (Bravdo et al., 1985; Murisier and Zufferey, 1996; Carbonneau, 1997).However, there is a little is known about the effect of fruiting shoot numbers on vigor growth and fruit quality of Ruby Seedless grapevines.

Therefore the aim of the research was to evaluate the effect of different levels of fruiting shoots on the Ruby Seedless productivity and fruit quality and its effects on the following season.

MATERIALS AND METHODS

The experiment was carried out on 7years-old "Ruby Seedless" grapevines (Vitis vinifera L.) during two successive seasons (2007/2008 and 2008/2009) in a private vineyard at EL-Dakahlia Governorate, Egypt. The vigor of selected vines was almost uniform. Vines were planted 2.5m x 3m apart in clay soil and were watered by drip irrigation. Trained to bilateral cordon and pruned in the first week of January, leaving 40 – 42 buds per vine. Treatments were imposed on different vines in both years, with follow up the residue effects for treatments in the next season on bud behavior, yield weight and fruit quality. Seventy five vines were used and divided into five treatments (fifteen each) according to fruiting shoots ratio.

1- **1** fruiting shoot :**1** vegetative
2- **2** fruiting shoot :**1** vegetative
3- **3** fruiting shoot :**1** vegetative
4- **4** fruiting shoot :**1** vegetative
5- **5** fruiting shoot :**1** vegetative

Around 3 to 36 shoots were retained on each vine. Excess shoots were removed (when the clusters start to be obvious). All fertilizer applications and pest control were applied commercially and as uniformly across the vineyard as possible. The experiment design was complete randomized block design. The vines subjected to five treatments with 3 replicates, 5 vines each.

Bud behavior

Number of bursted buds/vine was recorded; the percentage of bud burst was calculated by dividing number of bursted buds per vine / bud load per vine x 100. Bud fruitfulness was calculated by dividing cluster numbers/total shoot numbers. Fruitful buds % was calculated by dividing fruitful buds / burst buds x 100. Fertility coefficient was calculated by dividing number of clusters per vine / total number of buds load as mentioned by Bessis (1960).

Photosynthetic pigments

Eight leaves per replicate were collected from the middle part of the shoots for determination of chlorophyll a, b (mg. g^{-1} fresh weight), according to Wellburn (1994).

Leaf analysis:

Petiole of leaves opposite to the clusters were collected at version for chemical analysis N (Pregl, 1945), P (Chapman and Pratt, 1961), K (Brown and Lilleland, 1946).

Vine growth

Leaf area (cm^2) was measured from 15 leaves per vine positioned opposite to the basal clusters using a CL-203-Laser Area meter made by CID, Inc, USA.

Berry set percentage was measured by caging three clusters per vine in perforated white cheese bags before bloom start, at the end of berry development, bags were removed and berry set % was calculated as follows: Berry set % = number of berries / total number of flowers X 100.

Yield components and Fruit quality

At harvest (the end of August), yield (kg/vine), the number of clusters per vine was counted, cluster length and width (cm), the number of berries, cluster and rachis weight were recorded. Cluster compactness coefficient was calculated by dividing number of berries per cluster by length Winkler et al (1974). Bud fruitfulness (clusters/shoot), crop load (yield / pruning weight), shoot density (shoot / m canopy), leaf area / g fruit (cm^2/g) and leaf area (m^2 / vine) were calculated according to (Kliewer and Dokoozlian (2005).

The sample of 100 berries per vine was taken. The berry samples were first weighed to obtain mean berry weight (g). Berry length and diameter (mm) was calculated.

Berries were homogenized in a blender, whereupon the juice was filtered. Total soluble solid (TSS) of the juice was determined with a hand-held refractmeter (American Optical, Model 10430). Titratable acidity (as g tartaric acid per 100 ml juice) was determined by titration with 0.133 N NaOH using phenolphthalein as indicator, and the ratio of TSS/acid was calculated. Total anthocyanin in berry skin was determined according to Rabino et al., (1977**).**

Total carbohydrates content in the buds

Samples of 4 bunches-born canes were collected after harvest and at the pruning time in winter to determine total carbohydrates. Samples taken from the basal part of canes and cut into small pieces, oven dried at 70 ^{O}C for 72 hours and ground for the determination of total carbohydrates as g glucose /100 g dry weight. In samples of 0.1 g dried material ,total carbohydrates was determined colorimetrically at 490 nm using the phenol sulfuric acid method describe by Dubois et al., (1956).

Pruning weight and Coefficient of wood ripening

During the dormant season, vines were pruned on a vine-by-vine basis. One-year-old canes were separated from the old wood and were weighed. The pruning weights are reported. Coefficient of wood ripening calculated by dividing length of the ripened part by the total length of the shoot (Bouard1966)

Statistical analysis

Statistical analyses were performed using SPSS (SPSS Inc.). Analysis of variance was carried out using a general one–way model, and Duncan's Multiple Range Test was used for comparison between particular means (Gomez and Gomez, 1984). The correlations were carried out between different parameters.

RESULTS AND DISCUSSION

Photosynthetic pigments, petiole composition

Data in Table. 1 Shows the effect of various ratios of fruiting shoots on the content of chlorophyll a (chl.a) and chlorophyll b (chl.b); leaf analysis and leaf area .There was no significant difference between seasons. It is evident that 1:1, 2:1 and 3 fruiting: 1 vegetative significantly increased the content of chl.a and b. The maximum increase was resulted from 2:1 ratios. Vines with a high fruiting to vegetative shoots ratio (4:1 and 5:1) had a lower photosynthetic pigments, the increase in leaf chlorophyll content is proportional to the increase in nitrogen percentage in the leaves .The increased in N assimilation results in accumulation of nitrogenous reserves which become available for growth in the following year(Oland 1959). The vines with 1:1 ratio had the highest percentage of P and K in the leaves petiole than the other ratios. There was no significant difference in the leaves content of P and k between the other ratios. These results could be attributed to the increasing of the uptake of N, P and K % and their roles in building the chlorophyll.

Table 1. Influence of different fruiting shoots ratios on petiole composition (NPK), leaf chlorophyll a and b of Ruby Seedless grapevines in 2008 and 2009 seasons.

	Petiole mineral composition(%)									leaf content of chlorophyll (mg/g f.w)					
Treatment	**N %**			**P%**			**K%**			**chl a**			**chl b**		
	2008	**2009**	**average**	**2008**	**2009**	**average**	**2008**	**2009**	**average**	**2008**	**2009**	**average**	**2008**	**2009**	**average**
1 fruiting shoot :1 vegetative	0.84^{bc}	0.89^{c}	0.87^{b}	0.167^{ns}	0.172^{b}	0.168^{b}	3.2^{b}	3.0^{b}	3.10^{b}	0.591^{b}	0.605^{c}	0.598^{b}	0.492^{b}	0.489^{c}	0.491^{c}
2 fruiting shoot :1 vegetative	0.85^{bc}	0.91^{c}	0.88^{b}	0.159^{ns}	0.161^{ab}	0.160^{ab}	3.0^{ab}	2.8^{ab}	2.90^{ab}	0.588^{b}	0.624^{c}	0.606^{b}	0.486^{b}	0.492^{c}	0.489^{c}
3 fruiting shoot :1 vegetative	0.87^{c}	0.81^{b}	0.84^{b}	0.163^{ns}	0.151^{ab}	0.157^{ab}	3.0^{ab}	2.8^{ab}	2.9^{ab}	0.609^{b}	0.536^{b}	0.573^{b}	0.483^{b}	0.480^{b}	0.482^{b}
4 fruiting shoot :1 vegetative	0.77^{ab}	0.75^{ab}	0.76^{a}	0.155^{ns}	0.148^{a}	0.152^{a}	2.8^{ab}	2.9^{ab}	2.85^{a}	0.512^{a}	0.504^{ab}	0.508^{a}	0.474^{a}	0.475^{ab}	0.475^{a}
5 fruiting shoot :1 vegetative	0.73^{a}	0.70^{a}	0.72^{a}	0.147^{ns}	0.142^{a}	0.145^{a}	2.7^{a}	2.6^{a}	2.65^{a}	0.475^{a}	0.462^{a}	0.469^{a}	0.474^{a}	0.469^{a}	0.472^{a}

Different superscript letters are significantly different at $p < 0.05$.

Vine vigor

Leaf area (cm^2) and leaf area (m^2/vine) were significantly increased for vines with 3:1 ratios than the other ratios. The increase leaf area/vine of the 3:1 ratios may resulted in greater production of photosynthates (Williams, 1996). Leaf area per fresh fruit weight was the highest for 1:1 ratio (13 cm^2/g fruit). The leaf area required to produce 1kg fruits on 3:1 ratio (0.82) is lower (50% less) than that required on 1:1 ratio (1.29). The difference implies that in 1:1 ratio most of the leaf area is used to support vine growth, rather than fruit growth, the large part of this difference could be attributed to the energy expanded by the vine in producing vegetative growth.

Fruiting shoots ratio significantly influenced the leaves number per shoot. The vines with 2:1, 3:1 and 4 fruiting: 1vegetative shoots significantly increased leaves number/shoot by about 9, 9 and 15 %, respectively compared with the other ratios. There were no significant differences between 1:1 and 5:1 or between 2:1 and 4:1 ratios in shoot density .the vines with 3:1 ratio gave the lowest shoots density. All treatments significantly increased coefficient of wood ripening and the content of total carbohydrates in canes compared with the 1:1 ratio. In comparison with 1:1 ratio, the vines with3 fruiting: 1vegetative shoot showed the highest coefficient of wood ripening and content of total carbohydrates by 17.8, 12.7%, respectively.

Pruning weight as a measure of vine size and vine capacity, the vines with 3:1 ratio had the larger capacity by 35% over the 1:1 ratio to support a heavier crop. Also, 2:1 and 4:1 ratios significantly increased the pruning weight by 18 and 13% over the 1:1 ratio Whereas, 5:1 ratio had the smallest pruning weight by 12.2% less than the 1:1 ratio. On the other hand shoot density has been used to indicate if vines are well balanced, i.e., with neither too little nor too much growth, values of 1.5 to 2.15 of shoot density (shoots/m canopy) are generally considered to be in optimal range and capable of producing high quality grape without loss in productivity (Kliewer and Dokoozlian, 2005) .All treatments significantly increased crop load (yield/ pruning weight) compared with 1:1 ratio. The vines with 1:3 had the highest crop load; there were no significant differences between 1:1 4:1 and 5:1 ratios. Generally, vines with crop load values between 8 to 10 are considered in the optimal range as a good criterion of vine balance (Table 2). A similar result was reported by Kliewer et al (2000) and Bravdo et al (1985). There is a strong correlation between leaf area (m^2/vine) and shoot density (r= 967**) and between leaf area and pruning weight (r=0.919**).

Table. 2 Influence of different fruiting shoots ratios on vine vigor of Ruby Seedless grapevines in 2008 and 2009 seasons.

Vine vigor parameters	Fruiting / vegetative shoots ratio														
	1:1			2:1			3:1			4:1			5:1		
	2008	2009	average	2008	2009	average	2008	2009	average	2008	2009	average	2008	2009	average
Leaf area (cm^2)	135.2^{a}	133.7^{a}	134.4^{a}	142.1^{b}	141.6^{bc}	141.9^{b}	148.3^{c}	146.1^{c}	147.2^{c}	144.7^{bc}	139.1^{b}	141.9^{b}	138.1^{a}	135.3^{a}	136.7^{a}
Leaf area/ vine(m^2)	14.6^{a}	14.1^{a}	14.4^{a}	16.5^{b}	16.2^{b}	16.4^{b}	18.1^{c}	17.5^{c}	17.8^{c}	16.5^{b}	15.1^{ab}	15.8^{b}	14.6^{a}	14.4^{a}	14.5^{a}
Leaf area(cm^2/g fruit)	13.5^{d}	12.4^{c}	13.0^{d}	9.1^{b}	9.8^{b}	9.5^{b}	7.7^{a}	8.6^{a}	8.15^{a}	9.6^{b}	10.5^{b}	10.1^{bc}	11.0^{c}	10.15^{b}	10.58^{c}
Leaf area (m^2/kg/fruit)	1.35^{d}	1.24^{c}	1.29^{d}	0.91^{b}	0.98^{b}	0.95^{b}	0.77^{a}	0.86^{a}	0.82^{a}	0.96^{b}	1.05^{b}	1.00^{bc}	1.1^{b}	1.05^{b}	1.08^{c}
Leaves number/shoot	29.8^{a}	29.2^{a}	29.5^{a}	32.2^{b}	31.7^{bc}	32.0^{b}	33.9^{c}	33.3^{c}	33.6^{c}	32.5^{b}	31.0^{b}	31.8^{b}	29.5^{a}	29.2^{a}	29.4^{a}
Shoot density (shoots/m canopy)	2.5^{c}	2.6^{d}	2.55^{c}	2.1^{b}	2.2^{ab}	2.15^{b}	1.9^{a}	1.1^{a}	1.5^{a}	2.1^{ab}	2.4^{bc}	2.25^{b}	2.5^{c}	2.5^{cd}	2.5^{c}
Coefficient of wood ripening	0.773^{a}	0.779^{a}	0.776^{a}	0.885^{b}	0.877^{c}	0.881^{c}	0.921^{c}	0.907^{c}	0.914^{d}	0.879^{b}	0.829^{b}	0.854^{c}	0.803^{a}	0.812^{ab}	0.808^{b}
Cane total carbohydrates (%)	17.3^{a}	17.6^{ab}	17.45^{a}	18.9^{b}	18.3^{bc}	18.6^{b}	19.5^{c}	19.9^{d}	19.7^{c}	18.5^{b}	18.6^{c}	18.55^{b}	17.4^{a}	17.1^{a}	17.25^{a}
Pruning weight(kg/vine)	1.77^{a}	1.73^{a}	1.75^{a}	2.1^{b}	2.0^{b}	2.05^{b}	2.3^{c}	2.4^{c}	2.35^{c}	2.1^{b}	1.8^{bc}	1.95^{b}	1.6^{a}	1.5^{a}	1.55^{a}
Crop load (yield / pruning weight)	6.5^{a}	6.9^{a}	6.7^{a}	9.1^{bc}	8.5^{b}	8.8^{bc}	10.1^{c}	8.9^{b}	9.5^{d}	8.2^{b}	8.3^{b}	8.25^{b}	8.9^{b}	9.2^{b}	9.05^{bc}

Different superscript letters are significantly different at $p < 0.05$.

Yield components

As shown in Table. 3, length and width of cluster significantly increased by 2:1 ratios in comparison with the other fruiting shoots ratio.5 fruiting: 1vegetative shoots gave the smallest cluster than the other treatments. There is a wide range of cluster weight by different ratios (300g to 630g) as average two seasons. The 2:1 ratio gave the heaviest cluster weight than the other treatments. While, 4:1 and 5:1 ratio resulted in the lower cluster weight by 96 and110%, respectively less than the2 fruiting: 1vegetative shoots ratio. All treatments significantly increased rachis weight than the 1:5 ratios. Although the differences between 4:1 and 5:1 were significant but the differences among 1:1, 2:1 and 3:1 was not significant, and the1:1 ratio gave the heaviest rachis weight compared with other treatments. Compactness coefficient and berries number were significantly increased with 1:1, 2:1 and 3:1 ratios compared with 4: 1 and 5:1 ratios, and the vines with 2:1 ratios resulted in the highest berry numbers(268 berries) and compactness coefficient(8.8).In addition, berry set was significantly increased by the lowest ratio of fruiting shoots.

Berry length and diameter were significantly increased by 1:1 and 2:1 ratios compared with other treatments. The vines with 2:1 and 3:1 ratios resulted in the heaviest berry weight due to the largest berries. Moreover, the data indicate that 0.82 to 0.95 m^2 leaf area per kg was needed to produce maximum berry weight. This finding agree with the data of Kaps and Cahoon(1989) which found that 0.8 to 1.0 m2 leaf area per kg was required to maximum berry weight of Seyval blanc cultivar.

Bud behavior and its effects on bud behavior next season

Table .4 shows that fruiting shoots retained in the first season not only influenced bud burst percentage but also influenced number and weight of clusters. All treatments significantly increased bud burst % compared with 5:1 ratios the vines with 1::1 and 2:1 resulted in the highest percentage .The bud burst % was increased by 32.3,32.8, 26.2,14.5% ,respectively compared with the 5:1 ratio. Vines receiving high ratio of fruiting shoots tend to have lower percentage of bud burst. Fruitful buds percentage significantly increased by increasing the ratio of fruiting shoots whereas the percentage of vegetative buds decreased. Bud fertility coefficient significantly increased by increasing the fruiting shoots. While, there was no significant effect between the lowest ratios. Total clusters and its weighted were significantly affected by the preceding season. Vines with 3:1 ratios had the highest number of clusters per vine, and decreased with increasing the ratio. Cluster from vines with high ratio of fruiting shoots in the previous season had few berries, resulting in markedly smaller mean cluster weight. This and the lower bunch numbers significantly reduced average fruit yield per vines. For the vines with low ratio of fruiting shoots bunch numbers and weight were increased, therefore, there were significant differences in yield weight per vine. May et al. (1969) found reductions in bud burst, fruitfulness and cluster number per node, of field grown grapes, were directly related to the severity of defoliation in the previous season.

Fruit yields per vine were also reduced, largely through fewer berries per cluster and reduction in clusters weight. By maintaining high numbers of fruiting shoots Weaver and McCune (1960) reported reduced shoot and cluster numbers. Thus, yield in the following year. Furthermore, the vines entering dormancy with less carbohydrate in all vines parts. Therefore, poor bud burst as well as reduced cluster number and maturity in the following season. A highly significant correlation was found between total yield weight and leaf area m^2 /vine (r = 0.938**), and between total yield weight and coefficient of wood ripening (r = 0.938**) also, the data indicate that 0.82 to 0.95 m2 per kg fruit was needed to fully mature the Ruby Seedless crop under this experiment conditions.

Fruit quality

TSS % significantly increased by increasing the fruiting shoots ratio up to 1:3 ratio then significantly decreased by increasing the fruiting shoots ratio. However, in the following season gradually decreased by increasing the fruiting shoots. The data also revealed that 0.83 m^2 leaf area per kg fruit was needed to maximum the concentration of TSS% (20.6) (Table 5) This finding agree with May et al (1969) who reported that about 0.7 m2 of leaf area per kg of fruit was required to ripen Thompson seedless berries. Whereas, Kliewer and Antctiff (1970),and Kliewer and Ough (1970),using the same cultivar, found that 1.0 to 1.2 m2of leaf surface was necessary Total acidity was markedly affected by fruiting shoots ratio variables. 1:1 ratio gave the highest value. While, the highest ratio of fruiting shoots gave the lowest titratable acidity. In the following season titratable acidity significantly increased by increasing the fruiting shoot ratio. The vines with 3:1 fruiting shoots ratio gave the highest TSS/ acid ratio in the first season (40.3).whereas, in the following season, the lowest fruiting shoots ratio gave the highest ratio of TSS /acid. Using different Fruiting shoot ratios generally succeed to influence the anthocyanins content in the berries skin. All treatments significantly increased the anthocyanins content in the skin of berries compared with 3:1 fruiting shoots ratio. The lowest and the highest ratios gave the highest content in the berries skin. In the following season, the content of anthocyanins was significantly increased with the reduction in the fruiting shoots ratios. Furthermore, the finding that fruit coloration reaches maximum level at 1.07 to 1.29 m2 leaf area per kg fruit (Table 5).

A high number of fruiting shoots retained in the first season increased the time taken to reach harvest maturity (16% birx) .Vines with the lowest fruiting shoots reached harvest maturity first(11 days). The time taken to reach harvest maturity for vines with 4:1 and 5:1 ratios was protracted. It has been excluded from Table. 5 vines with 1:1 and 2:1 fruiting shoots reached harvest maturity in the following season, on average, one week before vines that had high ratio. Those vines that had 5:1 ratios reached harvest maturity in the following season two week later than 1:1ratio (Table.5).Differences between treatments in reaching 50% bud burst contribute to differences in time taken to reach harvest maturity and also due variations in leaf area per unit weight of fruit

Table 3. Influence of different fruiting shoots ratios on cluster and berry characteristics of Ruby Seedless grapevines in 2008 and 2009 seasons.

Cluster and berry characteristics	Fruiting / vegetative shoots ratio														
	1:1			2:1			3:1			4:1			5:1		
	2008	2009	average	2008	2009	average	2008	2009	average	2008	2009	average	2008	2009	average
Cluster length(cm)	28.3^{b}	29.3^{cd}	28.8^{c}	30.6^{c}	30.3^{d}	30.4^{d}	26.7^{ab}	27.3^{c}	27.0^{b}	26.6^{a}	27.3^{b}	27.0^{b}	25.2^{a}	25.9^{a}	25.6^{a}
Cluster width(cm)	16.2^{bc}	16.6^{b}	16.4^{b}	17.5^{d}	17.5^{c}	17.5^{d}	16.6^{c}	17.7^{c}	17.2^{c}	15.8^{b}	16.6^{b}	16.2^{b}	15.3^{a}	15.7^{a}	15.5^{a}
Cluster weight(g)	432b	457b	445^{b}	654^{d}	606^{c}	630^{d}	563^{c}	469^{b}	516^{c}	320a	324a	322^{a}	301^{a}	299^{a}	300^{a}
Rachis weight(g)	18.6^{c}	18.0^{c}	18.3^{c}	17.6^{bc}	16.9^{bc}	17.3^{c}	17.1^{bc}	18.4^{c}	17.8^{c}	16.3^{b}	15.4^{ab}	15.9^{b}	13.9^{a}	14.8^{a}	1 4.4^{a}
Compactness coefficient	6.9^{b}	7.2^{b}	7.1^{b}	9.1^{c}	8.5^{c}	8.8^{d}	8.7^{c}	6.9^{b}	7.8^{c}	5.2^{a}	5.3^{a}	5.25^{a}	5.4^{a}	5.2^{a}	5.3^{a}
Berry set %	19.5^{b}	19.8^{b}	19.4^{b}	17.5^{ab}	18.1^{ab}	18.2^{ab}	18.5^{ab}	17.3^{ab}	18.2^{ab}	17.2^{ab}	16.3^{a}	17.1^{ab}	16.2^{a}	16.2^{b}	16.6^{a}
Berries number	195^{b}	209^{b}	202^{a}	278^{d}	258^{c}	268^{c}	235^{c}	200^{b}	218^{b}	138^{a}	144^{a}	141^{a}	136.0^{a}	134.7^{a}	135^{a}
Berry length(cm)	1.87^{b}	1.85^{b}	1.86^{b}	1.87^{b}	1.83^{b}	1.85^{b}	1.77^{a}	1.80^{a}	1.79^{a}	1.76^{a}	1.81^{ab}	1.79^{a}	1.77^{a}	1.79^{a}	1.77^{a}
Berry diameter(cm)	1.75^{c}	1.72^{c}	1.73^{c}	1.63^{b}	1.66^{b}	1.65^{b}	1.58^{a}	1.63^{ab}	1.61^{a}	1.65^{b}	1.62^{b}	1.64^{a}	1.62^{ab}	1.59^{a}	1.61^{a}
Berry weight(g)	2.22^{a}	2.10^{a}	2.21^{a}	2.35^{bc}	2.30^{b}	2.33^{c}	2.39^{c}	2.4^{b}	2.39^{c}	2.33^{b}	2.30^{a}	2.32^{b}	2.21^{a}	2.2^{a}	2.22^{a}

Different superscript letters are significantly different at $p < 0.05$

Table 4. Influence of different fruiting shoots ratios and its residue in the following season on productivity attributes of Ruby Seedless grapevines in 2008 and 2009 seasons.

	Fruiting / vegetative shoots ratio														
Productivity	**1:1**			**2:1**			**3:1**			**4:1**			**5:1**		
attributes	**2008**	**2009**	**average**	**2008**	**2009**	**average**	**2008**	**2009**	**average**	**2008**	**2009**	**average**	**2008**	**2009**	**average**
Current season															
Bud fruitfulness	0.71^{a}	0.72^{a}	0.71^{a}	0.83^{a}	0.80^{a}	0.81^{a}	1.23^{b}	1.29^{b}	1.26^{b}	1.59^{c}	1.41^{b}	1.50^{c}	1.36^{b}	1.35^{b}	1.36^{c}
Fruitful buds %	26.8^{a}	26.5^{a}	26.6^{a}	37.8^{b}	36.3^{b}	37.1^{b}	46.7^{c}	47.1^{c}	46.9^{c}	47.2^{c}	47.7^{c}	47.5^{c}	52.9^{d}	52.5^{d}	52.7^{d}
Vegetative buds %	26.8^{e}	26.5^{e}	26.7^{e}	18.9^{d}	18.2^{d}	18.6^{d}	15.4^{c}	15.9^{c}	15.7^{c}	11.8^{b}	11.9^{b}	11.5^{b}	10.6^{a}	10.5^{a}	10.6^{a}
Bud fertility coefficient	0.29^{a}	0.32^{a}	0.31^{a}	0.35^{a}	0.33^{a}	0.34^{a}	0.52^{b}	0.55^{b}	0.54^{b}.	0.66^{c}	0.58^{b}	0.62^{c}	0.58^{bc}	0.57^{b}	0.58^{bc}
Yield weight (kg /vine)	10.9^{a}	11.6^{a}	11.3^{a}	19.2^{c}	17.1^{b}	18.2^{c}	23.7^{d}	21.4^{c}	22.6^{d}	17.4^{c}	15.4^{b}	16.4^{c}	14.1^{b}	14.2^{ab}	14.2^{b}
Next season															
Bud burst %	76.9^{d}	79.6^{d}	78.3^{d}	78.2^{d}	78.9^{d}	78.6^{d}	74.3^{c}	74.9^{c}	74.6^{c}	68.0^{b}	67.3^{b}	67.7^{b}	59.2^{a}	59.1^{a}	59.2^{a}
Fruitful buds %	33.4^{a}	31.7^{a}	32.6^{a}	39.4^{b}	40.0^{b}	39.7^{b}	48.5^{c}	50.1^{c}	49.3^{d}	45.8^{c}	41.9^{b}	43.9^{c}	48.8^{c}	47.9^{c}	48.4^{d}
Vegetative buds %	20.5^{b}	19.6^{b}	20.1^{b}	18.2^{b}	18.5^{b}	18.4^{b}	14.8^{a}	14.3^{a}	14.6^{a}	13.3^{a}	14.4^{a}	13.9^{a}	12.9^{a}	14.3^{a}	13.6^{a}
Bud fertility coefficient	0.81^{a}	0.86^{a}	0.84^{a}	0.98^{a}	0.94^{a}	0.96^{a}	1.45^{b}	1.52^{b}	1.49^{b}	1.87^{c}	1.66^{b}	1.77^{c}	1.57^{b}	1.61^{b}	1.59^{bc}
Bud fruitfulness	1.24^{a}	1.23^{a}	1.24^{a}	1.37^{b}	1.36^{b}	1.37^{b}	1.51^{c}	1.57^{c}	1.54^{c}	1.55^{c}	1.48^{c}	1.52^{c}	1.58^{c}	1.54^{c}	1.56^{c}
Cluster weight(g)	409^{d}	425^{c}	417^{d}	448^{e}	450^{d}	449^{e}	362^{c}	356^{b}	359^{c}	261^{b}	247^{a}	254^{b}	230^{a}	235^{a}	233^{a}
Yield weight (kg /vine)	17.8^{c}	18.3^{b}	18.1^{c}	23.6^{d}	24.1^{c}	23.9^{e}	22.2^{d}	22.1^{c}	22.2^{d}	13.6^{b}	11.7^{a}	12.7^{b}	11.2^{a}	11.1^{a}	11.2^{a}

Different superscript letters are significantly different at $p < 0.05$

Table .5 Influences of different fruiting shoots ratios and its residue in the following season on berry juice quality and harvest date of Ruby Seedless grapevines in 2008 and 2009 seasons.

Berry juice quality and harvest date	Fruiting / vegetative shoots ratio 1:1			2:1			3:1			4:1			5:1		
	2008	2009	average	2008	2009	average	2008	2009	average	2008	2009	average	2008	2009	average
Current season															
TSS %	18.6^{a}	18.5^{a}	18.6^{a}	19.8^{b}	19.5^{bc}	19.7^{b}	20.9^{c}	20.3^{c}	20.6^{c}	20.1^{b}	19.2^{ab}	19.7^{b}	18.5^{a}	18.2^{a}	18.4^{a}
Total acidity %	0.61^{c}	0.63^{c}	0.62^{c}	0.53^{b}	0.58^{c}	0.56^{c}	0.50^{a}	0.53^{b}	0.52^{b}	0.57^{b}	0.60^{d}	0.59^{d}	0.49^{a}	0.48^{a}	0.49^{a}
TSS /Acid ratio	30.1^{a}	29.9^{a}	30.0^{a}	35.5^{b}	35.4^{c}	35.5^{b}	41.9^{d}	38.7^{d}	40.3^{d}	34.5^{b}	32.9^{b}	33.7^{b}	37.8^{c}	38.6^{d}	$3\ 8.2^{c}$
Total anthocyanins	0.64^{c}	0.67^{c}	0.65^{c}	0.51^{b}	0.55^{ab}	0.53^{b}	0.43^{a}	0.49^{a}	0.46^{a}	0.51^{b}	0.58^{b}	0.55^{b}	0.61^{c}	0.66^{c}	0.64^{c}
Harvest date			Aug 19			Aug 21			Aug 21			Aug 29			Aug 30
Next effect															
TSS %	18.9^{b}	20.9^{c}	19.9^{c}	19.9^{c}	19.7^{b}	19.8^{c}	18.7^{b}	19.4^{b}	19.1^{bc}	18.0^{a}	18.6^{a}	18.3^{ab}	17.8^{a}	18.2^{a}	18.0^{a}
Total acidity %	0.52^{c}	0.53^{e}	0.53^{a}	0.52^{b}	0.56^{c}	0.54^{b}	0.57^{a}	0.55^{b}	0.56^{c}	0.59^{b}	0.56^{d}	0.56^{c}	0.57^{a}	0.58^{a}	0.58^{d}
TSS /Acid ratio	36.2^{bc}	39.5^{c}	37.9^{c}	38.1^{c}	35.2^{b}	36.7^{c}	33.1^{ab}	35.4^{b}	34.3^{b}	30.6^{a}	33.1^{a}	31.9^{a}	30.9^{a}	31.6^{a}	31.3^{a}
Total anthocyanins	0.74^{c}	0.68^{b}	0.71^{c}	0.70^{c}	0.72^{b}	0.71^{c}	0.62^{b}	0.61^{a}	0.62^{b}	0.58^{b}	0.61^{a}	0.60^{b}	0.52^{a}	0.58^{a}	0.55^{a}
Harvest date			Aug 23			Aug 23			Aug 29			Sept 3			Sept 6

Different superscript letters are significantly different at $p < 0.05$

Conclusion

A wide range of fruiting shoots ratio were investigated to determine how much leaf area was required to fully ripen Ruby Seedless grape. The results found that about 0.8 to 1.2m^2 leaf area per kg fruit was needed to mature fruit bilateral cordon system. Vines that fell within the range of (8.8 to 9.5 crop load) was considered well balanced and capable of fully ripening their crop as well as producing high-quality grapes either for the current or the following season.

Our results suggest that leaving more than 3 fruiting shoots: 1vegetative shoot to support bunches development would not only adversely affect berry development and time taken to reach harvest maturity in the season, but also the subsequent season even when leaf area retained in that season is adequate to support berry development. Furthermore, leaving less than 3 fruiting shoots: 1 vegetative shoot may would decrease the current yield weight but will increase the following season yield weight and harvest date was earlier by almost one week

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تأثير النسب المختلفة من الافرخ الثمرية على المحصول وجودة الثمار فى العنب صنف روبى سيدلس فى الموسم الحالى والموسم التالى

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أجريت هذة الدراسة خلال مواسم 2007 / 2008 ، 2008 / 2009 على كرمات العنب صنف روبى سيدلس عمر سبع سنوات نامية فى أرض طينية بحافظة الدقهلية ، تروى بنظام الرى بالتنقيط. زرعت الكرمات على مسافة 2.5 فى 3 متر ، قلمت أثناء الاسبوع الاول من شهر يناير طبقا لنظام الكردون الثنائى مع ترك 40 -42 عين / كرمة. فرضت المعاملات على كرمات مختلفة كل عام مع متابعة تأثيراتها فى العام المقبل على سلوك البراعم ووزن المحصول وجودة الثمار. أستخدمت 75 كرمة وقسمت الى خمس مجموعات (كل مجموعة 15 كرمة) كما يلى : 1 فرخ ثمرى : 1 فرخ خضرى ، 2 فرخ ثمرى : 1 خضرى ، 3 فرخ ثمرى : 1 خضرى ، 4 فرخ ثمرى : 1 خضرى ، 5 فرخ ثمرى : 1 خضرى . وذلك بهدف الوصول الى أفضل نسبة بين الافرخ الثمرية والافرخ الخضرية تعطى أعلى محصول وأفضل جودة للثمارليس فقط فى العام الحالى ولكن ايضا فى الموسم التالى.

وقد أوضحت النتائج المتحصل عليها مايلى:

- زيادة محتوى الكلوروفيل أ، ب وكذلك زيادة محتوى الاوراق من النيتروجين والفسفور والبوتاسيوم للكرمات ذات النسبة المنخفضة من الافرخ الثمرية
- زيادة المساحة الورقية وعدد الاوراق / للفرخ مع انخفاض فى المساحة الورقية / كجم من وزن الحبات للكرمات ذات النسبة 1:2 ، 1:3 ، 1:4 .
- أعطت الكرمات ذات النسبة 1:3 أعلى كثافة للافرخ ، معامل لنضج الخشب ،كربوهيدرات كلية ، وزن خشب التقليم و حمولة المحصول.
- تأثرت الخصائص الطبيعية للعنقود سلبيا بزيادة نسبة الافرخ الثمرية عن 1:3
- أعطت النسبة 1:1 أعلى معامل تزاحم وعدد ثمار/ للعنقود
- تناقصت نسبة العقد بزيادة نسبة الافرخ الثمرية بينما ازداد طول وقطر الثمرة للكرمات الاقل فى نسبة الافرخ الثمرية و أعطت النسبة 1:3 أثقل وزن للحبات

- كل المعاملات تسببت فى زيادة البراعم المثمرة و % للبراعم الثمرية ومعامل الخصوبة مقارنة بأقل نسبة من الافرخ الثمرية فى حين انخفضت % للبراعم الخضرية بزيادة نسبة الافرخ الثمرية.
- أعطت النسبة 1:3 أعلى وزن للمحصول ثم تناقص بزيادة نسبة الافرخ الثمرية
- نقصت معنويا النسبة المؤية لتفتح البراعم وكذلك % للبراعم الخضرية بزيادة نسبة الافرخ الثمرية.
- أعطت الكرمات ذات النسبة 1:4 أعلى معامل لخصوبة البراعم كما أعطت النسبة 1:5 أعلى براعم مثمرة.
- فى الموسم التالى نقص وزن العنقود لكل المعاملات فى حين ازداد وزن المحصول للكرمات ذات النسبة الثمرية المنخفضة وظل ثابتا للكرمات ذات النسبة 1:3 بينما تناقص المحصول فى الموسم التالى مع زيادة نسبة الافرخ الثمرية.
- أنتجت الكرمات ذات النسبة 1:3 أعلى مواد صلبة ذائبة كلية وكذلك أعلى نسبة مواد صلبة الى الحموضة وأقل أنثوسيانين. بينما أنتجت الكرمات ذات النسبة 1:1 أعلى حموضة كلية وأعلى أنثوسيانين وكذلك أسرعت النضج. علاوة على ذلك أنتجت نفس النسبة أعلى جودة للثمار فى الموسم التالى.