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THE RELATIONSHIP BETWEEN LEAF NUMBER AND GROWTH, YIELD AND CLUSTER QUALITY OF RUBY SEEDLESS GRAPEVINES

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ABSTRACT

This investigation was carried out in a private vineyard located at Baramon Horticulture Station, Dakahlia governorate, to disclose the effect of leaf number on growth, yield and bunch quality of Ruby Seedless grapevines. Vines were ten-year-old and trained to the bilateral cordon system. The treatments were applied after fruit set as follows: 16, 14, 12, 10 and 8 leaves per shoot.

The results showed that slight removal of leaves leaving sixteen leaves/shoot gave the best results as compared to the severe removal of leaves leaving eight leaves/shoot. This treatment can be considered as an appropriate practice for achieving the best vegetative growth parameters, the highest yield and its components as well as improving the physical properties of clusters and increasing berry colouration and TSS%, while decreasing the acidity% of the juice.

INTRODUCTION

Little information have been available in the literature concerning leaf removal practice and its degree. Park and Kim (1982), who found that total leaf area was increased in the treatment where more leaves/cane had been left but individual leaf area was reduced. Fruit reducing sugars, anthocyanin contents of berry skin and berry weight were increased. Jackson (1986) recorded that high leaf/fruit ratio was resulted in high berry sugar and low acid levels in berry juice. TSS level increased only until a certain leaf/fruit ratio was reached, whereas acid content of the juice continued to change as the shoots grow. Also, Dhillon *et al.* (1990) noticed that when shoots were allowed to retain 5, 10 or 15 leaves/cluster, the highest berry weight was obtained with the retention of 15 leaves/cluster at post bloom phase. Moreover, Koblet *et al* (1994) in their trial on Pinot Noir grapevines mentioned that when 0, 2, 4, 6, 8 or 10 main leaves were removed acropetally from the shoot base 6 weeks after full bloom (fruits pea-size) found that the severe leaf removal at berry pea size, decreased yield and its quality. Satisha *et al.* (2000) found that leaving even 10 leaves above the bunch on fruit- bearing shoots was sufficient to improve the quality of grapes. Petrie *et al.* (2000) found that 33%- leaf-retained vines compensated for leaf removal by increasing leaf size compared with 66%-leaf-retained treatment and control.

The goal of this study was to determine the appropriate leaf removal and its effect on growth, yield and cluster quality of Ruby seedless grapevines.

MATERIALS AND METHODS

This study was conducted for two successive seasons (2005& 2006) in a private vineyard located at Baramon Horticulture Station, Dakahlia governorate, on mature Ruby seedless grapevines. The chosen vines were ten-year-old, grown in a clay loamy soil and irrigated by flood irrigation system. Vines were spaced 2.5 X 3 meters apart and trained to the bilateral cordon system. Pruning was carried out during the first week of March with bud load of (45 buds/vine) resulting in an average of 24-28 clusters/vine. The vines were spurring pruned and trellised according to the telephone system. Fifty four uniform vines were chosen. Each three vines acted as a replicate and each three replicates were treated by one of the following treatments after fruit set. 16, 14, 12, 10 and 8 leaves were left on the shoot in addition to the control (no leaves were removed).

*The following parameters were adopted to evaluate the tested treatments:-

At veraison stage, two vines were specified for sampling. A representative sample of 20 berries from the apical, middle and basal portions of the cluster was picked from each vine every week. Total soluble solids % (TSS) by means of a hand refractometer and total titratable acidity % as tartaric acid according to the (AOAC 1985) were determined in berry juice. Sampling continued for each treatment till TSS reached about 16-17% according to Tourky *et al.* (1995).

1. Yield and physical characteristics of clusters

Yield/vine was determined by multiplying average number of clusters/vine by average cluster weight.

Representative random samples of six clusters/vine were taken at harvest. Average cluster weight (g) and length (cm) were determined.

2. Physical and chemical characteristics of berries:

Berry weight (g) and berry size (cm^3) were measured. Percentage of total soluble solids in berry juice (TSS) was recorded using a hand refractometer and total titratable acidity as tartaric acid (%) was also determined (AOAC 1985). TSS/acid ratio was calculated meanwhile total anthocyanin content of berry skin (mg/100g fresh weight) was determined according to methods described by Husia *et al.* (1965).

At growth cessation, the following morphological and chemical determinations were carried out on 4 shoots / the considered vine:

3-Morphological characteristics of vegetative growth

1- Average shoot diameter (cm).
2- Average shoot length (cm).
3- Average leaf area (cm^2) of the apical 5^{th} and 6^{th} leaves using a planimeter.
4- Total leaf area/vine (m^2) was determined by multiplying average number of leaves/shoot by average leaf area then by the number of shoots per vine.

4-Chemical characteristics of vegetative growth

1- Leaf content of pigments (chlorophyll A and B) (mg/g fresh weight) of the 5th and the 6th leaves (Westein, 1957).
2- Leaf content of total nitrogen (%) (Pregl, 1945), phosphorus (%) (Snell and Snell 1967) and potassium (%) (Jackson, 1967).
3-Cane content of total carbohydrates (%) (Smith *et al.*, 1956).

5. Dynamics of wood ripening:

Four shoots/vine of the current season growth were tagged to follow up the rate of wood ripening monthly starting from mid of June till mid of October. Total length of the shoot as well as length of the part of the ripened shoot (changing from greenish to brownish color) were measured. Then, coefficient of wood ripening was calculated by dividing length of the ripened part by the total length of the shoot according to Bouard (1966).

6- Statistical analysis:

The complete randomized blocks design was adopted for the experiment. The statistical analysis of the present data was carried out according to the methods described by Snedecor and Cochran (1972). Averages were compared using the new L3D values at 5% level.

RESULTS AND DISCUSSION

• **Dynamics of maturity indices at various dates:-**

Harvesting indices (TSS% and acidity) were monitored every week from veraison till 17/8 in the first season and 20/8 in the second one.

TSS %

TSS % of the juice (Figure 1) increased steadily by time elapse throughout the considered sampling dates reaching sixteen peak on August 17 & August 20 for both seasons respectively. 16 leaves/shoot treatment and control reached or approached TSS % of 16% (maturity index described by Tourky *et al.*, 1995) prior to the last sampling date. At the last sampling date 17-Aug & 20- Aug for both seasons respectively, it is to be noticed that the two treatments 8 and 10 leaves/shoot did not reach a TSS of 16%. This result was true for both seasons.

Acidity %

Juice acidity % (Figure 2) decreased gradually throughout the considered sampling dates. The treatment of 16 leaves/shoot resulted in the least juice acidity as compared with the other treatments.

1. Yield and physical characteristics of clusters

Yield was significantly increased in the treatment sixteen leaves/shoot (15.3 & 15.2 kg) for both seasons respectively (Table, 1), while, eight leaves/shoot treatment gave the lowest values (10.9 & 11.0 kg) for both seasons respectively in comparison with other treatments for both seasons.

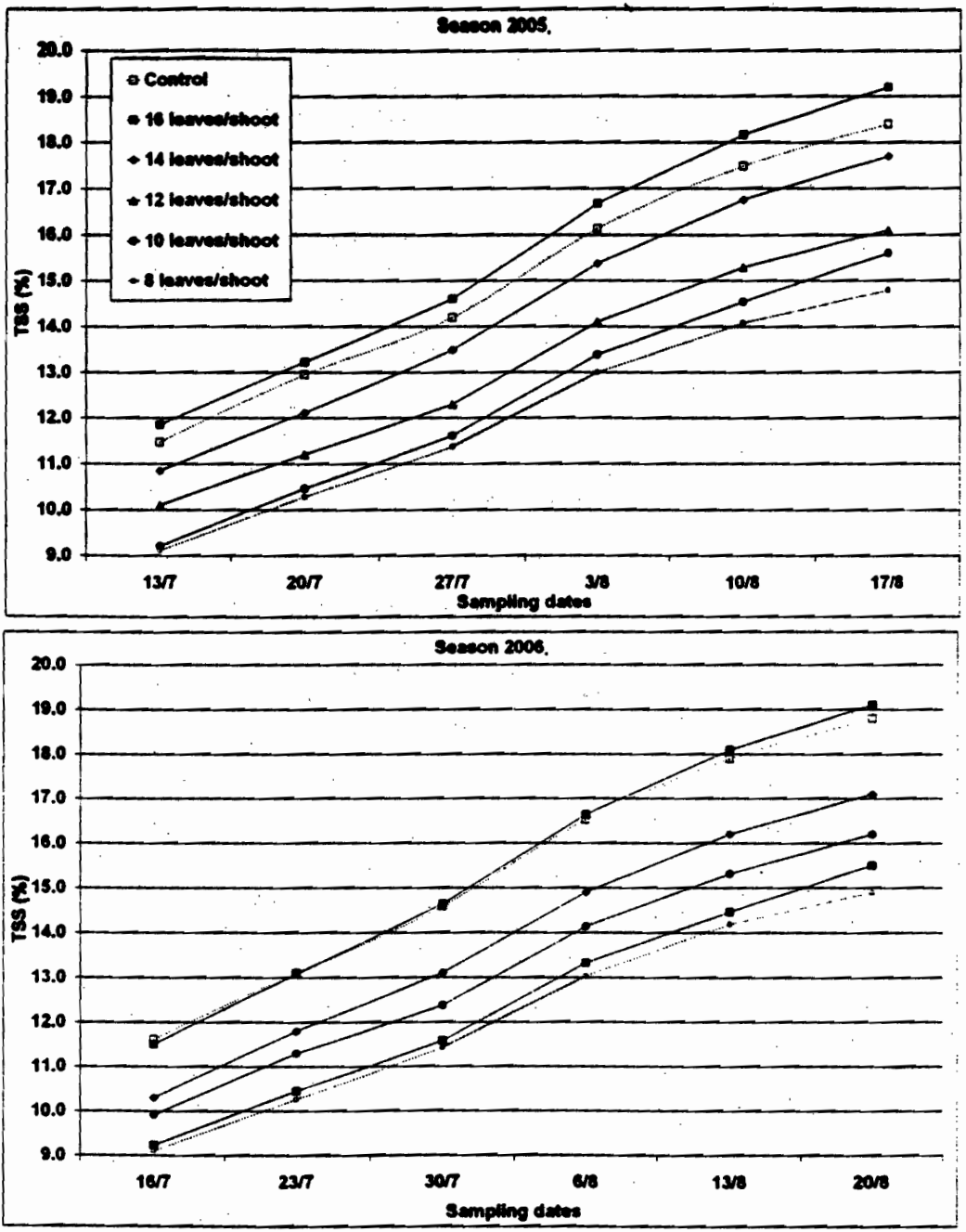

Fig (1): Average weekly TSS (%) in berry juice as affected by different treatments.

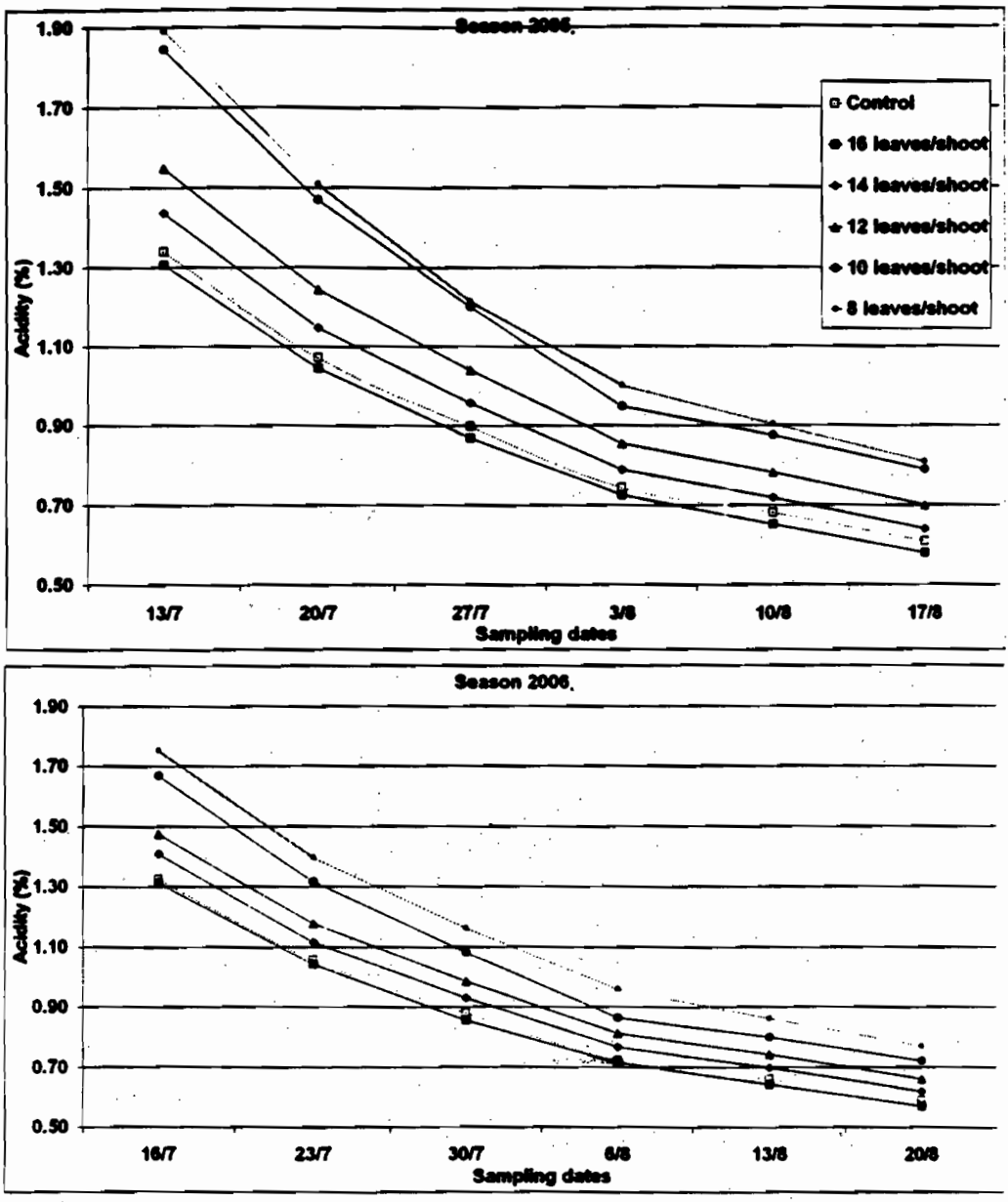

Fig (2): Average weekly acidity (%) in berry juice as affected by different treatments.

Table (1) : Effect of number of leaves per shoot on yield and some cluster characteristics of Ruby seedless grapevines

Treatment	Average yield (kg)		Average cluster weight (g)		Average cluster length (cm)	
	2005	2006	2005	2006	2005	2006
Control	14.9	14.8	600.6	610.0	31.0	30.9
16 leaves/shoot	15.3	15.2	631.3	630.3	32.0	31.8
14 leaves/shoot	14.1	14.0	581.7	581.6	29.9	29.9
12 leaves/shoot	12.9	13.1	504.7	507.0	29.1	29.2
10 leaves/shoot	12.1	12.2	457.6	456.0	28.4	28.6
8 leaves/shoot	10.9	11.0	405.3	400.6	27.9	27.8
new L.S.D. (0.05) =	0.3	0.2	28.7	19.4	1.3	1.6

Similar results were the obtained for cluster weight and length which were appreciably increased in sixteen leaves/shoot treatment.

Adjusting the number of clusters per vine made it logic to explain that increase or decrease the observed in the yield/vine could be ascribed only to the change of the cluster weight. The decrease in cluster weight in eight leaves/shoot treatment was due to the reduction of number of leaves per shoot (source) in relation to the cluster (sink).

The obtained results are nearly similar to those achieved by Koblet *et al.* (1994), Percival *et al.* (1994) and Omar (2005), who found that severe leaf removal at berry pea size, decreased yield and its quality.

2. Physical and chemical characteristics of berries:

Data in (Table 2) show that leaf removal treatments variably affected physical characteristics of berries i.e. berry weight and size. The severe removal of leaves by leaving eight leaves/shoot significantly decreased those parameters. On the contrary, the slight removal of leaves by leaving sixteen leaves/shoot significantly increased berry weight and size.

These results are in agreement with those obtained by Park and Kim (1982), Dhillon *et al.*, (1990), Kaps and Cahoon (1992), Koblet *et al.* (1994), Percival *et al.* (1994), Ollat and Gaudillere (1998) and Omar (2005), who found that severe leaf removal at berry pea size, decreased berry weight and size.

Results presented in (Table 2) revealed also that all berry chemical characteristics; i.e. TSS, Acidity, TSS/acid ratio and anthocyanin content of berry skin were significantly affected by degree of leaf removal. Leaving sixteen leaves/shoot generally resulted in higher percentage of TSS, TSS/acid ratio, anthocyanin content in berry skin and lower acidity of the juice as compared to eight leaves/shoot treatment.

The obtained results are in accordance with those obtained by Park and Kim (1982), Jackson (1986), Dhillon *et al.* (1990), Kaps and Cahoon (1992), Koblet *et al.* (1994), Hugelschaffer *et al.* (1994) and Omar (2005), who found that slight leaf removal at berry pea size, increased total soluble

solids of the juice and anthocyanin content of berry skin while decreased acidity compared to severe leaf removal.

3-Morphological characteristics of vegetative growth

Data in (Table 3) show that the highest values of vegetative growth parameters (expressed as shoot diameter, shoot length, total leaf area, total leaf area/cluster ratio) and coefficient of wood ripening responded positively to the slight removal of where leaving sixteen leaves/shoot were left as compared to severe leaf removal leaving eight leaves/shoot. Control and slight removal of leaves (sixteen leaves/shoot) were found to have the lowest values of individual leaf area.

The results in this respect are in line with those of Park and Kim (1982), who found that Total leaf area was increased after more leaves/shoot had been left, but individual leaf area was reduced. Also, Fournioux (1997), found that shoot maturation was positively, but not linearly, related to leaf number/shoot and the relationship varied between shoots.

The positive relationship between the extent of suberization and leaf number/shoot was confirmed. Moreover, Petrie *et al.* (2000), found that 33%-leaf-retained vines compensated for leaf removal by increasing leaf size compared with 66%-leaf-retained and control vines.

4-Chemical characteristics of vegetative growth

The effect of the conducted treatments on leaf pigments was significantly evident only with chlorophyll A. This effect was attributed to the slight removal of leaves by leaving sixteen leaves/shoot as compared to severe leaf removal by leaving eight leaves/shoot (Table, 4).

As for the percentages of total nitrogen, phosphorus and potassium of the leaves and total carbohydrate of the cane, it can be noticed that the slight removal of leaves by leaving sixteen leaves/shoot resulted in the highest significant increase in the seasons, while, the severe removal of leaves by leaving eight leaves/shoot resulted in the lowest significant values. These results are in agreement with those obtained by Cartehin and Palliotti (1995), found that the positive influence of the slight removed of leaves per shoot was manifested in enhancing the ability of more leaves to capture the light with wavelengths suitable for photosynthesis. Moreover, shading was found to impede chlorophyll degradation (Uhlig, 1998). Omar (2005), found that total chlorophyll was higher in shaded leaves than those situated in diffuse light or exposed to direct sunlight.

5. Dynamics of wood ripening:

Data illustrated in Fig. (3) clearly indicate that wood ripening gradually increased through the considered sampling dates for both seasons of the study. Concerning the effect of treatments, it is apparent that the highest increase in the rate of wood ripening from 30-August till 30-October was observed in the slight removal of leaves by leaving sixteen leaves/shoot (0.82 and 0.87) for both seasons respectively, whereas, the lowest rate was obtained from severe leaf removal bu leaving eight leaves/shoot (0.71 and 0.79) for both seasons respectively. Data illustrated in (Figure 4, 5 & 6) revealed the existence of a highly positive correlation between leaf number and average total leaf area per vine, between total leaf area and cluster weight and between total leaf area and yield in both seasons.

Table (2) : Effect of number of leaves per shoot on physical and chemical characteristics of berries of Ruby seedless grapevines

Treatment	Average berry weight (g)		Average berry size (cm3)		T.S.S. (%)		Acidity (%)		T.S.S./acid ratio		Anthocyanin (mg/100g F.W.)	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
Control	2.14	2.12	2.01	2.00	18.4	18.8	0.61	0.59	30.2	31.9	38.6	39.4
16 leaves/shoot	2.21	2.19	2.09	2.06	19.2	19.1	0.58	0.57	33.1	33.5	39.9	41.1
14 leaves/shoot	2.06	2.03	1.94	1.90	17.7	17.1	0.64	0.62	27.7	27.6	37.8	38.7
12 leaves/shoot	1.91	1.93	1.78	1.81	16.1	16.2	0.70	0.66	23.0	24.5	37.1	37.8
10 leaves/shoot	1.78	1.79	1.65	1.67	15.6	15.5	0.79	0.72	19.7	21.5	35.4	36.3
8 leaves/shoot	1.68	1.65	1.56	1.52	14.8	14.9	0.81	0.77	18.3	19.4	34.9	34.5
new L.S.D. (0.05) =	0.05	0.03	0.04	0.03	0.5	0.3	0.03	0.02	1.8	1.5	1.2	1.6

Table (3): Effect of number of leaves per shoot on morphological characteristics of vegetative growth and coefficient of wood ripening of Ruby seedless grapevines

Treatment	Shoot diameter (cm)		Shoot length (cm)		Leaf area (cm^2)		Total leaf area/shoot (cm^2)		Total leaf area/vine (m^2)		Total leaf area(m^2)/cluster ratio		Coefficient of wood ripening	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
Control	0.89	0.90	161.4	155.5	121.7	122.5	2678.2	2695.7	16.1	16.2	6.5	6.7	0.80	0.84
16 leaves/shoot	0.91	0.94	159.5	152.4	151.2	154.9	2419.2	2478.4	14.5	14.9	6.0	6.2	0.82	0.87
14 leaves/shoot	0.80	0.82	154.0	149.1	152.7	155.3	2138.3	2173.6	12.8	13.0	5.3	5.4	0.79	0.83
12 leaves/shoot	0.72	0.72	143.4	140.2	154.3	157.6	1851.6	1891.5	11.1	11.3	4.3	4.4	0.76	0.82
10 leaves/shoot	0.64	0.62	137.5	135.3	157.5	159.8	1575.1	1598.4	9.5	9.6	3.6	3.6	0.73	0.80
8 leaves/shoot	0.55	0.56	123.8	121.7	161.8	163.4	1294.2	1307.4	7.8	7.8	2.9	2.9	0.71	0.79
new L.S.D. at 0.05 =	0.02	0.03	5.4	3.2	5.6	3.5	274.3	291.7	1.7	1.8	0.7	0.8	0.02	0.03

Table (4): Effect of number of leaves per shoot on chemical characteristics of vegetative growth of Ruby seedless grapevines

Treatment	Chlorophyll (A) (mg/g F.W.)		Chlorophyll (B) (mg/g F.W.)		N (%)		P (%)		K (%)		Total carbohydrates (%)	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
Control	0.51	0.52	0.22	0.24	2.80	2.82	0.21	0.22	1.50	1.51	21.9	22.2
16 leaves/shoot	0.52	0.54	0.23	0.24	2.94	2.93	0.24	0.23	1.63	1.67	24.1	24.9
14 leaves/shoot	0.48	0.47	0.20	0.23	2.78	2.79	0.22	0.22	1.49	1.50	20.5	20.7
12 leaves/shoot	0.45	0.44	0.19	0.21	2.47	2.50	0.20	0.21	1.41	1.43	18.9	19.2
10 leaves/shoot	0.44	0.43	0.19	0.20	2.41	2.42	0.20	0.19	1.25	1.29	17.6	17.8
8 leaves/shoot	0.40	0.41	0.18	0.19	2.33	2.35	0.19	0.19	1.13	1.15	16.3	16.6
new L.S.D. at 0.05 =	0.01	0.02	N.S	N.S	0.13	0.10	0.02	0.01	0.12	0.15	2.1	2.5

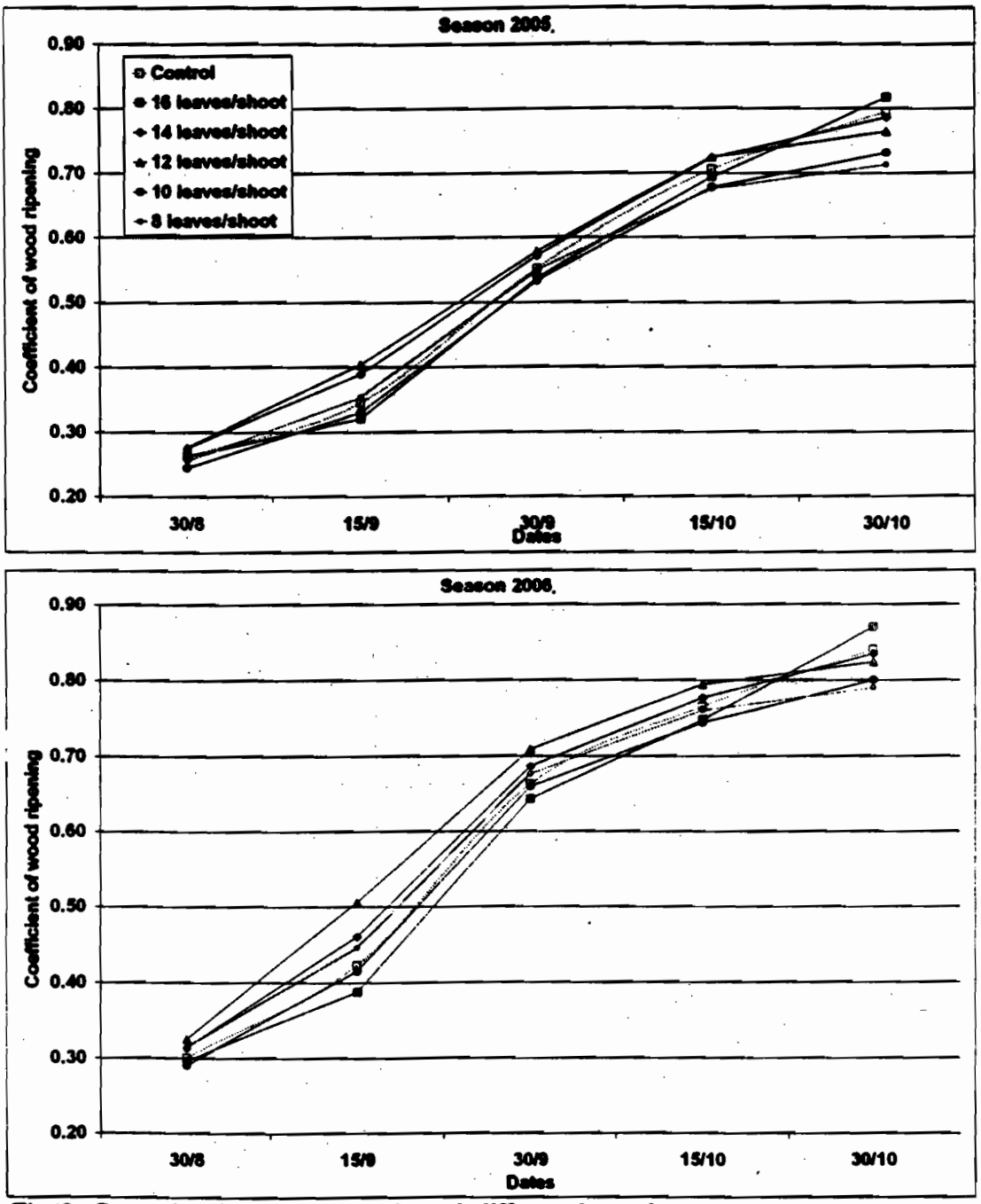

Fig (3): Dynamics of wood ripening through different dates of measurements.

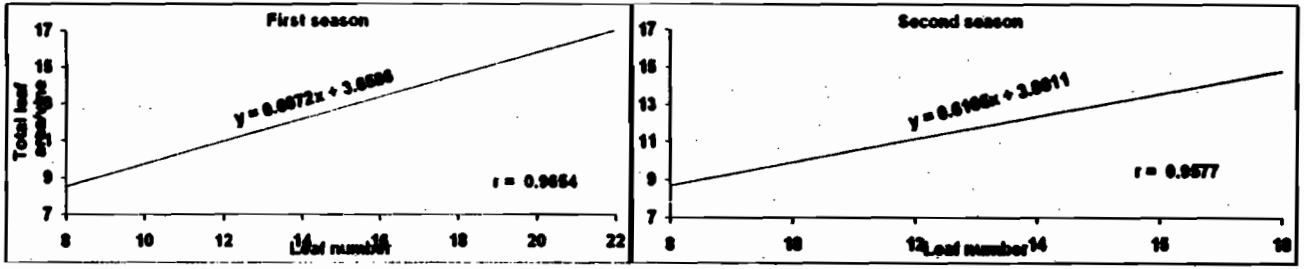

Fig (4): The relationship between leaf number and total leaf area/vine (m^2) in both seasons

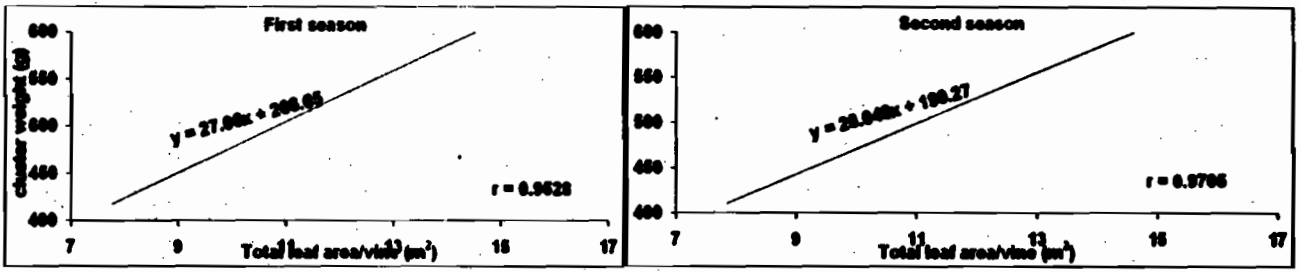

Fig (5): The relationship between total leaf area/vine (m^2) and cluster weight (g) in both seasons

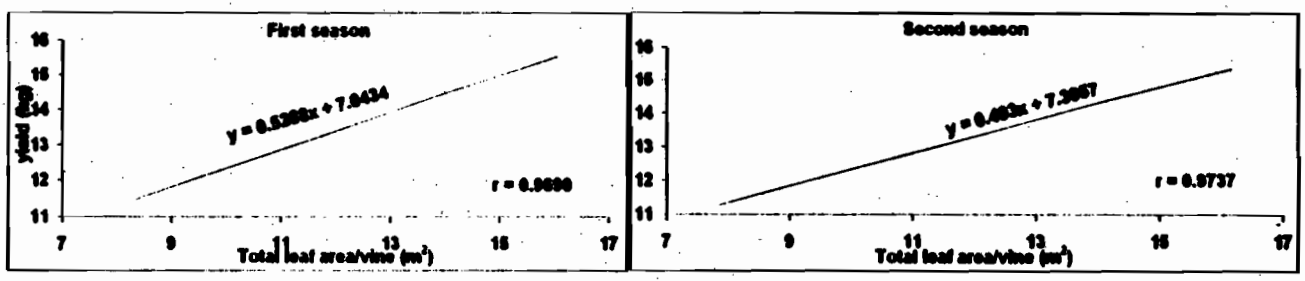

Fig (6): The relationship between total leaf area/vine (m^2) and yield (kg) in both seasons

In conclusion, it can be said that the quality of Ruby seedless grapes could be easily improved by slight removal of leaves with leaving sixteen leaves/shoot. This practice can be considered as an appropriate treatment for ensuring the best vegetative growth parameters, yield and cluster quality for Ruby Seedless grapevines.

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العلاقة بين عدد الأوراق والنمو والمحصول وجودة العناقيد لكرمات عنب الروبى سيدلس

سوسن عبد الوهاب بندق

قسم بحوث العنب – معهد بحوث البساتين – مركز البحوث الزراعية بالجيزة

أجرى هذا البحث لدراسة تأثير إختلاف عدد الأوراق على الأفرخ على النمو والمحصول وجودة ثمار عنب الروبى سيدلس. تم إجراء المعاملات بترك عدد مختلف من الأوراق بعد العقد: ١٦، ١٤، ١٢، ١٠، ٨ ورقة لكل فرخ بعد العقد بالاضافة إلى الكنترول.

أشارت نتائج الدراسة إلى أن إزالة الأوراق بدرجة طفيفة بترك ١٦ ورقة لكل فرخ أعطت أفضل النتائج مقارنة بالازالة الشديدة للأوراق بترك ٨ ورقات لكل فرخ من خلال أفضل قياسات خضرية، أعلى محصول، بالاضافة إلى تحسين الصفات الطبيعية للحبات مع أعلى نسبة من المواد الصلبة الذائبة الكلية وأقل حموضة فى العصير مع تحسين لون الحبات.