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EFFECT OF OLD WOOD SIZE ON BUD BEHAVIOUR, TOTAL YIELD AND BUNCH QUALITY OF ROUMI AHMAR GRAPE CULTIVAR

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ABSTRACT

This study was conducted for two successive seasons 2009 and 2010 at a private vineyard located at El-Khatatba region on 16-years-old. Roumi Ahmar grapevines. Grapevines were irrigated by the drip irrigation system, trained as double cordon on double T trellis system. Total number of buds per vine was fixed to (64 buds) (16 spurs X 4 buds each). The aim of this work to study the effect of old wood size on total yield per vine, bunch quality, bud behaviour and dynamic of wood ripening. Old wood size was varied as to give rise to three levels: high (13-15 Dec^3), medium (11-12 Dec^3) and low (8-10 Dec^3).

The obtained results indicated that there were significant increases on bud behaviour expressed as percentage of bud burst, percentage of fruitful buds and bud fertility as old wood size was increased. Data showed that yield/vine, number of bunches per vine, bunch weight, weight of rachis, average berry weight and percentage of total soluble solids increased as size of old wood was increased. Also, wood ripening was found to increase by increases size of old wood.

The weight of wood prunings was determined as Kg per vine. The values were considered as an indicator for vine vigour. This estimate was shown to increase by increasing size of old wood: While, No of berries per bunch, berry index, compactness coefficient and acidity were decreased. Bud behaviour at the different position lengthwise the spur from (1^{st} bud to 4^{th} bud) was found to increase i.e. as percentage of bud burst, percentage of fruitful buds and bud fertility were increased as old wood size was increased.

From these results it can be included the importance of old wood size on yield/vine and bunch and berry quality of Roumi Ahmar grapevines.

INTRODUCTION

Roumi Ahmar grape cultivar is one of the old important grape cultivars commercially grown in Middle Egypt especially in Elmenia Governorate. Vines are vigorous, and the clusters are large and loose (Isis *et al*., 1995). Old wood should not be regarded only as a principal structural element for the vine but also as a reservoir for storing nutritive substances and a connective pathway for water, mineral salt and assimilates during the growth season (Popov *et al*., 1969 and Hassan *et al*., 1991).

Many investigators mentioned that high trunk and training system had a great effct on yield and bunch quality (Dragamov, 1969, Popov *et al*., 1969, Radulov *et al*., 1972, Rangelov and Boichev, 1977, Namazov and Gvgeinov, 1983, Cimaco and Chaves, 1984, Tomer and Brar, 1984, Reynolds *et al*., 1995, Hassan *et al*., 1991, Popescu, 1994, Tardea *et al*., 1996 and Abbas, 2001).

Vine vigour as vigour of separate shoots, yield and quality of bunches exist in a very tight and complicated correlationship. The relationship between vine vigour and old wood size on the formation of fruitful buds was been investigated.

Levels of bud load and number and size of arms (size of old wood) should be taken into consideration (Hassan *et al*., 1991).

Studies in Austria (Konlechner, 1961) and (Stoev and Dobreva, 1976) among others suggested that the perennial wood obtained from the use of high trunks could lead to increase the soluble solids in the fruit (Aisha, 2007).

The amount of old wood retained on a grapevine can also affect both yield and fruit composition. Koblet and Porret (1982) and Aisha, (2007) demonstrated that old wood in Vitis vinefera cultivars acted as a carbohydrate reservoir leading to higher values yield/vine, cluster weight and fruit soluble solids.

The size of old wood must be developed progressively depending on vigor in order to regulate the water flow and increase the reserves close to bunches (Carbonneau, 1999).

Weaver and Kasimate (1975) found that increasing trunk height and the use of cross arms (old wood) could increase yield and fruit maturity.

Increasing the functional photosynthetic surface area of the vine by increasing the reservoir for photosynthates through the retention of significant quantities of old wood, may have major impacts on vine performance and fruit composition (Hassan *et al*., 1991 and Aisha, 2007).

In this respect few researches studied this relashionship between the size of old wood and the vine productivity (Hassan *et al*., 1991 and Abbas, 2001) on Italia and Flame Seedless grapevines.

The present study was carried on Roumi Ahmar grapevines to reveal the relationship between size of old wood per vine and all growth parameters to get the highest possible yield with good bunch quality.

MATERIALS AND METHODS

Ninety six vines of Roumi Ahmar grape cultivar were chosen for this investigation which extended for two successive seasons (2009 and 2010). The vines were grown in a private vineyard located at El-Khatatba, Menofia Governorate, Egypt. Vines were sixteen years old, trained to the double cordon with double T trellis, planted at 1.75X2.5 meter apart, grown in a sandy soil and irrigated by the drip system. All vines were subjected to the same cultural practices already give to the vineyard. At winter pruning time (first of January) vines were pruned and bud load was fixed to 64 buds per vine (sixteen spur with four buds; each).

Size of old wood was varied so to give rise to three levels (low, medium and high). Size of old wood was determined by measuring the size of different parts of the above ground, included trunk, arms and all units of more than one year old. Circumference and length of these parts were measured. Size of old wood was calculated according to the following equation:

$S = л \times D^2 x L$

S = is the total size of old wood

π = is a constant which equals 3.14

L = is the length of the measured part of old wood (more than one year old), including trunk and arms.

Sizes of separate old wood parts were added to each other, giving rise to the total size of old wood parts for each vine (Popov *et al*., 1969).

Owing to the considerably great number of vines and according to the variation of old wood size, it was possible to classify vines to three levels according to the size of old wood (Treatments):

1- Low: size of old wood: 8-10 Dec^3 (T1)
2- Medium: size of old wood: 11-12 Dec^3 (T2)
3- High: size of old wood: 13-15 Dec^3 (T3)

Each treatment contained 32 vines as 8 vines were replicated four times.

Vegetative measurements:-

At the commencement of growth season, the following parameters were recorded:

1- Bud behaviour: Percentage of bud burst, Percentage of fruitful buds and bud fertility per vine, these parameters were calculated as follows:

Bud burst% = No of bursted buds per vine x100
No of total buds per vine left at pruning time

Fruitful buds% = No of fruitful buds per vine X100
No of bursted buds per vine

Fertility coefficient was calculated by: No of clusters per vine
No of total buds left at winter pruning

Fertility coefficient was determined as mentioned by (Huglin, 1958)

2- Yield per vine: At harvest time the number of bunches per vine and their total weight in (Kg) were recorded.
3- Mechanical structure of bunches: Sixteen bunches per each level of old wood were taken at harvest to determine the following parameters:
    1. Average bunch weight in (gm), dimensions (length and width) in (cm) and average weight of rachis per bunch in (gms).
    2. Coefficient of bunch compactness: calculated by dividing number of berries per bunch by bunch length according to (Weaver, 1962).
    3. Bunch index as average weight of berries per bunch divided by average weight of rachis.
    4. Berry index as average number of berries per 100 gms of bunch weight.
    5. Average weight of 100 berries in grams.
    6. TSS and acidity: Juice acidity was determined by titration against Nacl 0.1 in the presence of phenolphthalein as indicator and acidity was calculated in the juice as tartaric acid.
4- Weight of pruning wood: At pruning time, the weight of one year old wood prunings was determined as Kg per vine. The values were considered as an indicator for vine vigour.
5- Wood ripening: measuring were carried out on 16 shoots per each level of wood size by measure the part of the shoot that ripened i.e., (changing its color from greenish to brownish) as mentioned by Stoev and Dobreva (1976).

    The measurements were carried out at 21 days intervals, from the beginning of September until the end of November, then coefficient of wood ripening was calculated by dividing the length of ripened part by the total shoot length according to Bouard (1966).

From the statistical point of view, the treatments were arranged in a completely randomized design. Data were subjected to analysis of variance and the new LSD test was used for comparing between each two means (Snedecor and Cocharn, 1990).

RESULTS AND DISCUSSION

Bud behaviour:

Regarding the percentage of bud burst, percentage of fruitful buds and fertility coefficient, data of both seasons (Table, 1) showed the existence of significant differences between treatments, T1 gave the highest values of these parameters indicating the importance of size of old wood level in raising the values of these estimates.

The correlation between the size of old wood and bud burst and fruitful buds and bud fertility is apparently shown in Fig. (1) where the two parameter increased as the size of old wood was increased.

As shown in table (4), percentage of bud burst, percentage of fruitful buds and bud fertility at each bud position (1^{st} to 4^{th}) lengthwise, the fruiting unit were found to increase as size of old wood was increased starting from 1^{st} to the 4^{th} bud position at the two seasons 2009 and 2010. These results go in the same line with Abd El-Fatah *et al* (1993) and Isis *et al* (1995) who stated that Roumi Red grape variety which is characterized by having strong growth and branches needs short pruning (spur pruning) from 2-4 buds per spurs.

These results are in harmony with those reported by Fawzi *et al* (1984) who found that percentage of bud burst and fruitful buds and fertility coefficient increased significantly at the high level of old wood size and ascribed this increase to the higher content of nutritive substances and water stored in the old wood.

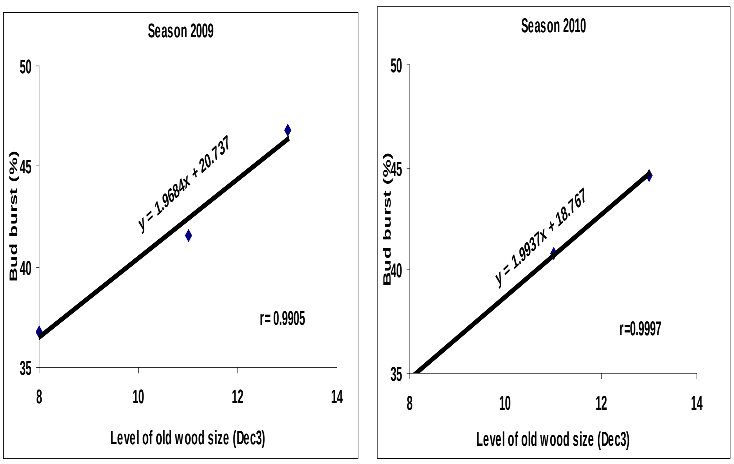


Fig (1): Relationship between old wood size levels (Dec^3) and bud burst (%)

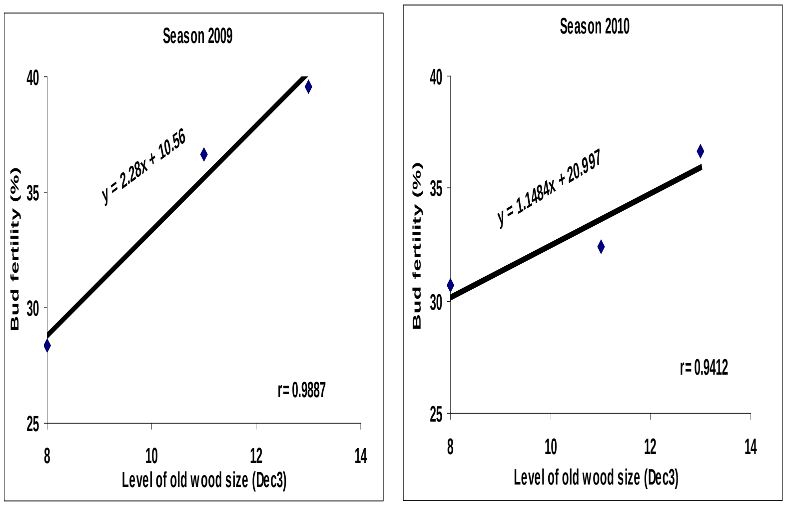


Fig (2): Relationship between old wood size levels (Dec3) and bud fertility (%)

The increase in percentage of fruitful buds and fertility coefficient can be attributed to the increase in bud burst and also to the increase of old wood size and its promoting effect on the process of flower bud indication as mentioned by Nikov (1962).

Concerning the effect of old wood size on yield per vine, data presented in Table (1) indicated that both high and medium levels of old wood size significantly increased the yield/vine as compared to the low level of old wood size.

Data illustrated in Figure (3, 4) indicate the presence of a highly positive correlation between the size of old wood size and total yield/vine and between the size of old wood and bunch weight.

The amount of old wood in the grapevine can affect the yield and fruit quality, this may be attributed to the increased photosynthetic capacity (Kliewer *et al*., 2000).

These results are in accordance with (Reynolds and Wardle 1994, Carbonneau, 1999, Abd El Ghany and Marwad 2001 and Ashia 2007) who found that the size of old wood must be developed progressively depending on vine vigor in order to regulate the water flow and increase the reserves close to bunches.

A significant increase in the yield/vine can be observed by increasing vine trunk which indicates the storage of more carbohydrates, water and starch. These results were given by several investigators. Radulov *et al* (1972), Namazov and Gvgeinov (1983), Fregons *et al*. (1984), Guseinov and Kruchinina (1984), Fawzi *et al* (1984), Abd El-Fatah *et al* (1993), Abbas (2001) and Aisha (2007).

Concerning the weight of prunings, it was significantly increased by increasing the level of old wood size (T1) ranked first in this respect, followed descending by (T2) and (T3) (Table, 1). This result can be attributed to the size of old wood size which acts as reserving sites of starch, water and total carbohydrates in the trunks and other parts more than one year old. These results are in agreement with those mentioned by Abbas (2001) and Aisha (2007).

Bunch weight and number of bunches per vine were the two components accounting for the higher yields.

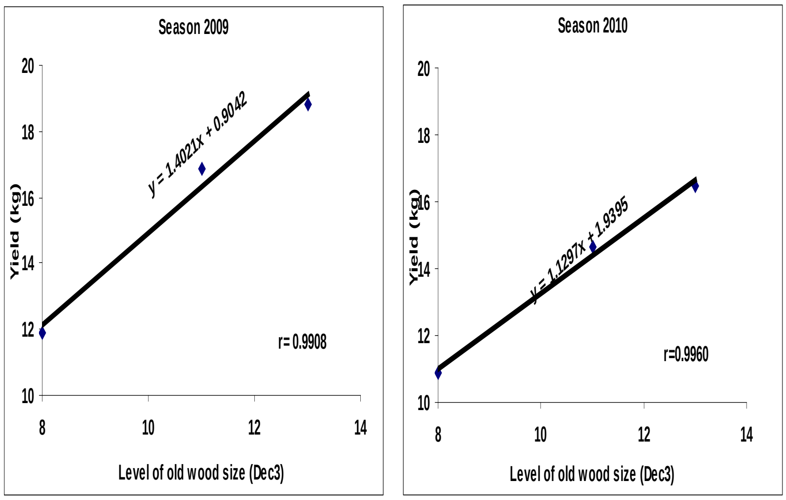


Fig (3): Relationship between old wood size levels (Dec^3) and yield (kg)

Fig (4): Relationship between old wood size levels (Dec^3) and bunch weight

The higher yields recorded in 2009 and 2010 could be due to the greater number of bunches produced as a result of the great size old wood.

Mechanical structure of bunches:

As for the effect of old wood size on bunch weight and bunch dimensions, data in Table (2) revealed that the high and medium old wood size (T1 and T2) significantly increased bunch weight and bunch dimensions in comparison with (T3), (low old wood size) which gave the lowest bunch weight and dimensions.

These results are in the same line with Abbas (2001) and Aisha (2007).

Concerning bunch compactness (Table, 2), it can be noticed that the parameter decreased as size of old wood with increased being the highest in (T1). This result can be ascribed to that high trunks and long arms allowed vine foliage to increase light interception and reduce canopy density. These results are in line with those obtained by (Weaver and Kasimatis 1975, Orth and Chambers (1994) and Abd El-Ghany and Marwad 2001).

Bunch index

The same trend was also found with bunch index parameter, the high old wood size (T1) gave the least values followed in ascending order by the medium old wood size (T2) and the low old wood size (T3). These values were (22.23, 22.62), (28.60, 25.08) and (31.43, 29.02) for the two seasons respectively. These results may be attributed to the number of berries per bunch which was the lowest in (T1). These findings are in the same line with Fawzi *et al* (1984), Abbas (2001) and Aisha (2007), they found that the highest size of old wood is was foud to give of big size berries.

Concerning the effect of old wood size on coefficient of bunch compactness Table (2) showed that this parameter decreased as size of old wood was increased. These results are quite expected for the recorded less No of berries per bunch and the length of bunch at the high old wood size (T1). The results are in agreement with those obtained by Hassan *et al* (1991), Papescu (1994), Tardea *et al* (1996) and Abbas (2001).

Berry quality

As shown in Table (3) berry weight and berry index were significantly affected by old wood size. Average berry weight was significantly increased by increasing old wood size. Berry index had the same trend in the two seasons under investigation. These results are in accordance with Popov *et al* (1969), Fawzi *et al* (1984) and Abbas (2001) who mentioned that fruiting units situated on large arms are usually characterized by having large bunches and berries.

TSS and acidity:

As for TSS and acidity it is evident from Table (3) that TSS increased and acidity decreased significantly with the higher old wood size while acidity was found to increase at the lowest value of old wood size.

The same trend was found with berry weight by increasing, sugars and nutrient substances were increased berry juice as mentioned by Fawzi *et al* (1984), Abd El-Fatah *et al* (1993) and Abbas (2001).

Namazov and Gvgeinov (1983) pointed out that meanwhile shoot length, leaf area per vine and per Kg, crop and photosynthetic potential decreases with increased.

1-2-3

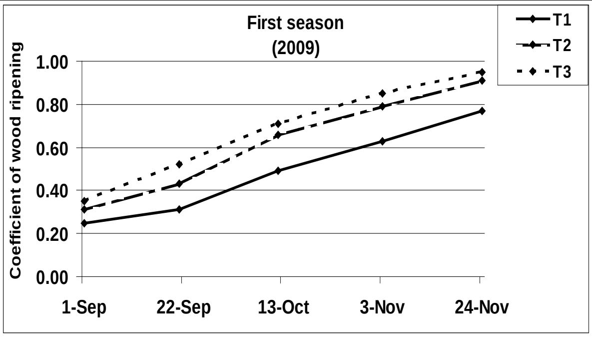
As for coefficient of wood ripening, it is clear from Fig. (5) that coefficient of wood ripening gradually increased through the considered sampling dates for the two seasons of the study.

Concerning the effect of treatments, it is apparent from the same figure that the highest increase in the rate of wood ripening was observed through the period from 1-Setember till 24-November, this increase wood ripening was detected as size of old wood was increased at the two seasons 2009 and 2010, the lowest rate of wood ripening was obtained from treatment which having the least size of old wood.

In conclusion, these results explain the role of old wood in increasing yield, bunch weight and improving berry quality of Roumi Ahmar grapevines especially at the old age vineyards. So we can improve the quality of bunches by making balance between the size of old wood and the spurs left at pruning.

Table (4): Effect of old wood size on bud behaviour lengthwise the fruiting unit at the two seasons (2009 and 2010).

Old wood size (Dec3)	2009								2010							
	1st		2nd		3rd		4th		1st		2nd		3rd		4th	
	BB	FB	BB	FB	BB	FB	BB	FB	BB	FB	BB	FB	BB	FB	BB	FB
T1	14.4	7.0	16.6	8.40	18.0	8.8	16.8	8.5	10.6	5.8	14.8	7.6	18.6	8.5	18.0	8.8
T2	16.0	8.8	18.8	9.80	20.6	10.4	18.4	9.0	11.8	6.6	19.4	9.8	21.8	10.8	20.3	9.6
T3	18.6	9.0	20.0	10.65	22.4	11.6	20.6	9.6	14.6	7.5	20.8	11.3	24.6	12.6	22.4	10.8



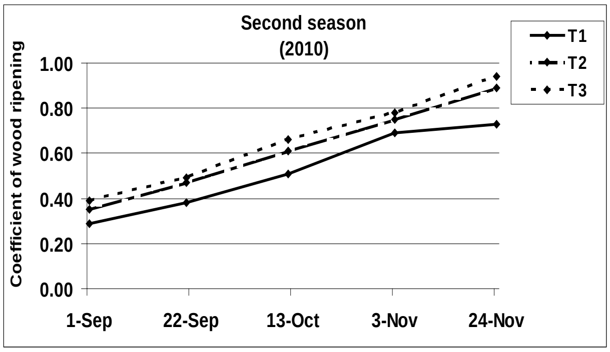


Figure (5): Effect of old wood size on coefficient of wood ripening of Roumi Ahmar grapevines in 2009 and 2010 seasons

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تأثير حجم الخشب القديم على سلوك العيون والمحصول وصفات العناقيد فى صنف العنب الرومى الأحمر

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أجرى هذا البحث لمدة عامين متتاليين (2009،2010) بمزرعة عنب رومى أحمر خاصة عمرها ستة عشر عاما بمنطقة الخطاطبة وتروى بنظام الرى بالتنقيط على 96 كرمة مرباة بطريقة الكردون المزدوج وقد تم تثبيت عدد العيون على 64 عين للكرمة (16 دابرة x 4عين).

تعرضت جميع كرمات المعاملات المختلفة لكافة عمليات الخدمة التى تجرى عادة بالمزرعة. والهدف من الدراسة هو معرفة تأثير حجم الخشب القديم المتمثل فى الجذع والأذرع والدوابر (يقصد بالخشب القديم كل النموات الناضجة التى يصل عمرها إلى سنتين فأكثر) على صفات المحصول والعناقيد والحبات وعلى سلوك العيون وديناميكية نضج الخشب.

وقد تم تحديد الخشب القديم طبقا لحجمه إلى ثلاث مستويات: الأول (T1) (من 8 - 10 م3) والثانى (T2) (من 11 - 12 م3) والثالث (T3) (من 13 - 15 م3).

أظهرت النتائج زيادة معنوية فى كل من نسبة تفتح العيون ونسبة العيون الثمرية ومعامل الخصوبة بزيادة حجم الخشب القديم. كما زاد متوسط وزن محصول وعدد عناقيد الكرمة. كما زاد متوسط وزن العنقود ووزن الشمراخ ووزن الحبات ونسبة المواد الصلبة الذائبةالكلية ووزن القصاصة عند التقليم وأبعاد العنقود بزيادة حجم الخشب القديم عن المستويين القليل والمتوسط.

إزدادت سرعة نضج القصبات فى المعاملة ذات الحجم الأكبر للخشب القديم عن المعاملتين الأقل حجما وتأثر عكسيا بزيادة حجم الخشب القديم كل من متوسط عدد الحبات بالعنقود ودليل الحبات ومعامل تزاحم الحبات بالعنقود والحموضة. كما أوضحت الدراسة تأثر سلوك العيون تأثيرا واضحا على موقع العين الأولى حتى الرابعة بزيادة واضحة فى مستوى الحجم الأكبر للخشب القديم عنه تحت مستويات حجم الخشب المتوسط والقليل.

من هذا يتضح أهمية حجم الخشب القديم فى تحسين صفات العناقيد والحبات وكذا مدى تأثيره الملحوظ على سلوك العيون وزيادة المحصول الكلى للكرمة فى صنف الرومى الأحمر.

قام بتحكيم البحث

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Table (1): Effect of old wood size on bud behaviour, yield, number of bunches per vine and weight of pruning wood in the two seasons (2009 and 2010).

Old wood size (Dec3)	Bud burst %	Fruitful buds%	Fertility coefficient	No of bunches/ vine	Yield/vine (kg)	Weight of wood pruning (kg)	Bud burst%	Fruitful buds%	Fertility coefficient	No of bunches/vine	Yield/vine (kg)	Weight of wood pruning (kg)
	2009						2010					
T1	36.8	28.40	0.42	23	11.90	1.2	34.66	30.66	0.41	22	10.86	0.95
T2	41.6	36.64	0.48	27	16.88	1.90	40.84	32.44	0.47	25	14.66	1.54
T3	46.8	39.60	0.52	32	18.80	2.65	44.60	36.64	0.50	28	16.45	2.30
LSD 0.05	3.3	2.00	0.021	3.40	1.63	0.40	2.80	1.46	0.023	2.11	1.96	0.33

Low: size of old wood: 8-10 Dec^3 (T1)
Medium: size of old wood: 11-12 Dec^3 (T2)
High: size of old wood: 13-15 Dec^3 (T3)

Table (2): Effect of old wood size on mechanical characteristics of bunches at the two seasons (2009 and 2010).

Old wood size (Dec3)	Av. bunch weight (gm)	Rachis weight (gm)	Bunch index	Av. bunch length (cm)	Av. bunch width (cm)	No of berries/bunch	Av. berries weight (gm)	Coefficient of compactness	Av. bunch weight (gm)	Rachis weight (gm)	Bunch index	Av. bunch length (cm)	Av. bunch width (cm)	No of berries/bunch	Av. berries weight x No of 100 berries	Coefficient of compactness
	2009								2010							
T1	330	10.50	31.43	18.4	11.3	138	301.9	7.50	280	9.65	29.02	17.00	9.5	135	185.85	7.94
T2	385	13.46	28.60	21.0	16.6	125	355.5	5.95	310	12.36	25.08	19.50	14.5	120	235.00	6.15
T3	410	18.44	22.23	24.8	18.8	110	380.4	4.44	380	16.80	22.62	22.66	16.8	95	376.63	4.19
LSD 0.05	21.5	2.50	1.6	1.10	1.6	6.64	6.13	0.66	22.0	1.90	1.9	1.80	2.11	9.5	8.73	0.46

Table (3): Effect of old wood size on berry quality at the two seasons (2009 and 2010).

Old wood size (Dec3)	Weight of 100 berries (gm)	Berry index	TSS (%)	Acidity (%)	Weight of 100 berries (gm)	Berry index	TSS (%)	Acidity (%)
	2009				2010			
T1	210	91.48	14.0	0.63	190	89.61	13.4	0.66
T2	265	92.34	16.0	0.59	235	90.97	14.6	0.64
T3	280	92.78	17.6	0.54	265	94.16	16.8	0.58
LSD 0.05	23.00	0.9	0.94	0.02	21.64	1.2	0.91	0.01