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Effect of Vine Bud Load on Bud Behavior, Yield, Fruit Quality and Wood Ripening of Superior Grape Cultivar

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Abstract This study was carried out during two successive seasons, 2006 and 2007 in order to find out the optimum number of buds to be left on the vines of superior grapevines to get the highest possible yield with the best fruit quality besides maintaining vine Vigor. Severn years – old – uniformed vines chosen and pruned to seven different levels of bud load, namely, 77, 84, 91, 98, 105, 112 and 119 buds/vine. The results of this investigation showed that the percentages of busted buds and fruitful buds decreased with increasing the bud load/vine, while the fertility coefficient was not affected by pruning level in both seasons. Increasing of bud load/vine increased number of bunches but decreased yield/vine. In addition, increasing bud load on the vine significantly decreased bunch weight, bunch length, bunch index, rachis weight, berry weight, berry firmness, number of berries/bunch, T.S.S. and T.S.S / acid ratio while, Total acidity % increase as bud load increase Acidity was increased .While, wood ripening and on the other hand wood ripening and total carbohydrates decreased by increasing bud load/vine. Results also showed that 98 or 105 buds/vine is more suitable for superior grapevines to produced good yield and fruit quality.

Keywords: superior cv., bud load, bud behavior, fertility coefficient, fruit quality, wood ripening.

Introduction

Grape (*Vitis vinifera* L.) is one of the most wildly cultivated fruit crop all over the world, covering an area of more than 10 million hectares. In Egypt, it is one of the most important fruit crops of temperate zone, it is considered the second most important fruit crop after citrus. The planted area reached 188543 fedan in 2013 producing 1378815 tons (Ministry of Agriculture statistics). Superior grape is one of new cultivars which were introduced to Egypt and characterized by its earliest crop, and has bunches light to medium weight, long to medium length, shouldered loose to semi compact and cylindrical, winged shape. The berries are seedless, greenish white to light golden, ripening date at El-Tahreer region – el behara governorate - Egypt is from June 14 to June 21 according to Haggag *et al.* (1996).

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Many investigation studies the effect of can length and bud load per vine on fruit quality and yield of Thompson seedless grape cultivar (Lider *et al.*, 1973, Sourial 1976, Fawzi *et al.*, 1984, Rizk *et al.*, 1994, and Omar & Abdel-kawi 2000). Bud load is the most important factor affecting yield and bunch quality. Total yield was increased by increasing bad load, but the percentage of marketable bunches was decreased (Miller *et al.*, 1993 and Korpas, 1994). Little attention has been paid on pruning severity of superior grapes and its effect on wood ripening.

The objective of this study is carried out to determine the optimum number of bud load per vine for superior grapes and study bud behavior, yield and fruit quality with different level of bud load.

Materials and methods

This work was carried out during 2006 and 2007 seasons in a private vineyard at El-Galatma region - Giza governorate- Egypt. Superior grape vines of 7-year-old were grown 2 x 3 meters apart in sandy soil under drip irrigation and trained according to cane pruning system (**Y-shape**). At winter, Sixty three vines nearly similar in growth and vigor were chosen with fixed number of canes (7 canes per vine) and seven renewals spur (2buds/spur) per vine. The experimental vines pruned to different bud load levels 9, 10, 11, 12, 13, 14, and 15 buds/cane while cane number was fixed for all treatments (7 canes per vine).

The Treatments were as follows:

1- Bud load = 77 buds/ vine.
2- Bud load = 84 buds/ vine.
3- Bud load = 91 buds/ vine.
4- Bud load = 98 buds/ vine.
5- Bud load = 105 buds/ vine.
6- Bud load = 112 buds/ vine.
7- Bud load = 119 buds/ vine.

The randomized complete block design with three replicates and three vines per each replicate was used. The following parameters were determined to evaluate the effect of different bud load levels on bud behavior, yield and fruit quality:

1- Bud behavior:

During the spring of each season, number of bursted buds, numbers of fruitful buds were counted. Then, percentages of bud burst and fruitful buds were calculated by using the following equations:

$$\text{Bursted buds } 5\% = \frac{\text{Number of bursted buds/vine}}{\text{Total number of buds / vine}}$$

$$\text{Fruitful buds 5\%} = \frac{\text{Number of fruitful buds/vine}}{\text{Number of bursted buds}}$$

Fertility coefficient was calculated by dividing number of bunches per vine by total number of buds per vine as mentioned by Huglin (1958) and Bessis (1960).

***2- Number of bunches and yield/vine*:**

At harvest time (1st week of June) bunches were picked in each season then the average number of bunches /vine were calculated, and their total weight/vine (kg) were recorded.

***3- Physical characteristics of bunches*:**

Representative random samples of 3 bunches for each replicate were picked at harvesting time and taken the laboratory to caring out the following measurements:

a- Average bunch weight.
b- Average bunch length.
c- Bunch index (average bunch weight divided by average rachis weight).
d- Average rachis weight.

***4- Physical characteristics of berries*:**

Samples of 100 berries from each replicate were collected randomly to determine an

a- Average Berry weight (g).
b- Average berry firmness (g/cm^2) using push-pull (Dynanometer model PT 101).
c- Average number of berries / bunch.
d- compactness Coefficient was calculated by Winkler (1962) as follows:

$$\text{Coefficient} = \frac{\text{No. of berries / bunch}}{\text{Bunch length cm}}$$

***5- Chemical characteristics of berries*:**

Berry juice was extracted and filtered through two layers of cheese cloth to determine:

a- Total soluble solids percentage using hand refractmeter.
b- Titratable acididity by litrating 10 ml juice sample against NaoH (0.1N). Acidity was expressed as (g) tartaric acid per 100 cm^3 of the juice according to A.O.A.C (1980).
c- Total soluble solids/acid ratio in berry juice was calculated.

6- *Wood ripening and Total carbohydrate*:

Coefficient of wood ripening was calculated as follows:

$$\text{Wood ripening} = \frac{\text{Length of ripening part}}{\text{Total length of the shoot}}$$

The part of the shoot that ripened is changing in color from greenish to brownish (Bouard, 1966).

Total carbohydrates, at the end of growing season ripened canes were collected in December for determination of total carbohydrates according to methods of Dubois *et al*. (1956).

The obtained data were statistically analysis and the new L.S.D at 5% was used for comparison between means representing the bested treatments (Snedecor and Cochran, 1972).

Results and Discussion

1- Bud behavior and fertility coefficient

Data concerning the effect of bud load/vine on bud behavior and fertility coefficient of superior seedless cv. are shown in Table (1). It is clear that increasing the number of bud/vine significantly decreased bud burst percentage. It is obvious that the high bud load of 119 buds/vine gave a lower bud burst percentage it recorded (73.10 and 70.30%) in the two seasons, respectively. This result is in line with those obtained by Omar and Abdel-Kawi (2000) and El-Baz *et al*. (2002).

With regard to the effect of bud load/vine on fruitful buds percentage of superior grape cultivar data presented in Table (1) clearly show that fruitful buds percentage significantly decreased as bud load increased. However, bud load of 98 or 105 buds/vine gave a higher values in this respect were recorded (61.16 & 63.12% and 63.30 & 65.11%) in two seasons, respectively.

As for the fertility coefficient there were no significant among the treatments in both seasons of this study the same results were obtained by Fawzi *et al*. (1984) on Thompson seedless grapevines.

Table 1. Effect of bud load on bud behaviour and fertility coefficient of "superior" grapevines.

Treatments (Bud load / vine)	Burested buds (%)		Fruitful buds (%)		Fertility Coefficient	
	2006	2007	2006	2007	2006	2007
77 Bud / vine	86.33	84.30	56.60	58.33	0.18	0.21
84 Bud / vine	83.30	82.11	58.30	59.10	0.18	0.21
91 Bud / vine	82.60	79.30	59.31	61.33	0.19	0.23
98 Bud / vine	79.33	76.23	61.16	63.12	0.23	0.27
105 Bud / vine	76.30	75.10	63.30	65.11	0.24	0.26
112 Bud / vine	75.30	73.33	51.00	49.30	0.24	0.26
119 Bud / vine	73.10	70.30	50.30	48.55	0.25	0.26
New L.S.D. at 5%	5.6	5.9	2.90	4.30	N.S	N.S

2- Number of bunch and yield

Data concerning the effect of bud load on number of bunches/vine are presented in Table (2). It is obvious that leaving 112 or 119 buds/vine gave the highest number of bunches were recorded (27 & 29 and 30 & 31) in the two seasons, respectively, However, leaving bud load of 77 bud/vine gave a number of bunches/vine which recorded (14 * 16) bunch/vine in both seasons, respectively.

As for yield/vine it also clear from Table (2) that bud load of 98 or 105 buds/vine gave a higher yield/vine were recorded (8.63 & 9.92 kg and 9.66 & 10.60 kg/vine) in the two seasons, respectively. The increase in yield may be due to the high number of bunches produced and the increasing in bunch weight in above mentioned treatments.

On the other hand, the least values were recorded for lower and higher bud load i.e 77 or 119 buds/vine. These data go in line with those reported by Fawzi, *et al*. (1984), Marwad *et al*. (1993) and Omar & Abdel-Kawi (2000).

Table 2. Effect of bud load on number of bunch and yield per vine of "superior" grapevines

Treatments (Bud load / vine)	Number of bunches		Yield / vine (k.g)	
	2006	2007	2006	2007
77 Bud / vine	14	16	4.35	4.74
84 Bud / vine	15	18	4.88	5.67
91 Bud / vine	17	21	5.84	7.25
98 Bud / vine	23	26	8.63	9.92
105 Bud / vine	25	27	9.66	10.60
112 Bud / vine	27	29	6.70	7.34
119 Bud / vine	30	31	6.76	7.33
New L.S.D. at 5%	3.10	3.30	3.10	3.30

3- Physical characteristics of bunches

Data presented in Table (3) showed that bunch weight decreased significantly as bud load was increased. It obvious that bud load of 98 or 105 buds/vine gave the heaviest bunches in both seasons, (375.10 & 381.66 and 386.30 & 392.63 g), respectively. However, bud load of 77 or 119 buds/vine gave the lowest values in this respect. These results are in harmony with those obtained by Omar & Abdel-Kawi (2000).

Concerning bunch length data presented in Table (3) showed that vines pruned at 119 buds/vine produced the shortest bunch of superior grapevines in both seasons (17.33 & 18.90 cm) , regarding bunch index it is clear from the same Table that, highest values was found for treatment pruned at 91 buds / vine which recorded (22.72 & 22.85) in both seasons, respectively.

With regard to the effect of bud load/vine on rachis weight, it obvious from Table (3) that the effect of the different used treatments (bud load) on bunch weight were almost similar to that of rachis weight.

Table 3. Effect of bud load on physical characteristics of bunches of "superior" grapevines

Treatments (Bud load / vine)	Bunch weight (g)		Bunch length (cm)		Bunch index		Rachis weight (g)	
	2006	2007	2006	2007	2006	2007	2006	2007
77 Bud / vine	311.33	296.16	31.16	33.10	21.76	22.22	14.31	13.33
84 Bud / vine	325.11	315.11	32.30	31.33	22.41	22.57	14.51	13.96
91 Bud / vine	343.32	345.33	30.36	32.31	22.72	22.85	15.11	15.11
98 Bud / vine	375.10	381.66	25.33	27.30	218.	21.43	17.30	17.81
105 Bud / vine	386.30	392.63	27.10	28.33	20.88	20.31	18.50	19.33
112 Bud / vine	248.33	253.21	18.36	19.23	18.63	18.76	13.33	13.50
119 Bud / vine	225.30	236.33	17.33	18.90	16.93	18.03	13.31	13.11
New L.S.D. at 5%	8.6	9.3	4.10	4.30	2.5	2.3	1.66	2.30

4- Physical characteristics of berries

As shown in Table (4) it is evident that berry weight (g) was significantly decreased as bud load increased. Thus, vines pruned at 98 or 105 buds buds/vine results in somewhat increment in the average berry weight than the other treatments which recorded (2.91 & 3.11 and 3.18 & 3.25 g) in the two seasons, respectively. These results are in accordance with Abdel-Fattah *et al*. (1993), Rizk (1996) and Ali *et al*. (2000).

Concerning berry firmness the results in the same Table indicated that berry firmness of superior grape was decreased by increasing bud load/vine. The least value was obtained in vines pruned at 119 buds/vine which recorded (617.33 & 596.31 g/cm^2) in the two seasons, respectively. While, the highest value was found at pruning 105 buds/vine which recorded (673.33 & 648.11 g/cm^2) in both seasons respectively.

As for number of berries/bunch data presented in Table (4) showed that number of berries/bunch significantly decreased as bud load was increased. Least value was found at 119 buds/vine which recorded (85.48 & 90.74) in the two seasons, respectively. While the highest value was

obtained at pruned 98 buds/vine it recorded (122.96 & 118.99) in the two seasons, respectively.

Data presented in Table (4) indicated that compactness coefficient was significantly increased by increasing bud load/vine of superior grape. This increment in compactness may be to the short length of bunch. These results were true in both seasons. In this respect Haggag *et al*. (1996) mentioned that the bunch of superior grape are light long to medium length and loose to semi-compact.

Table 4. Effect of bud load on physical characteristics of berries and compacters coefficient of "superior" grapevines

Treatments (Bud load / vine)	Berry weight		Berry firmness (g/cm^2)		No. of berries / bunch		Compactness Coefficient	
	2006	2007	2006	2007	2006	2007	2006	2007
77 Bud / vine	2.58	2.63	650.23	630.18	115.12	107.54	3.69	3.25
84 Bud / vine	2.63	2.71	643.11	623.33	118.09	111.13	3.66	3.55
91 Bud / vine	2.75	2.83	630.16	610.11	119.35	116.69	3.93	3.61
98 Bud / vine	2.91	3.11	671.33	650.30	122.96	116.99	4.85	4.29
105 Bud / vine	3.18	3.25	673.33	648.11	115.66	114.86	4.27	4.05
112 Bud / vine	2.51	2.50	621.16	599.30	93.62	95.88	5.22	4.99
119 Bud / vine	2.48	2.46	617.30	596.31	85.48	90.74	5.24	4.80
New L.S.D. at 5%	0.43	0.33	28.30	30.33	7.30	8.33	0.36	0.66

5- Chemical characteristics of berries

Data concerning the effect of bud load/vine on T.S.S, Acidity and T.S.S/acid ratio of superior grapes in 2006 and 2007 seasons are shown in Table (5). It is evident from the obtained data that T.S.S % significant decrease as bud load was increased. Leaving 112 or 119 buds/vine were recorded lower values T.S.S. % (16.50 & 16.63 and 16.33 & 15.93) in the two seasons respectively. Thus leaving 98 and 105 buds/vine gave higher values of T.S.S% were recorded (17.82 & 17.93 and 18.12 & 18.36) in both seasons, respectively. The same observation was recorded for T.S.S/acid ratio It is obvious from Table (5) that the effect of the different used treatments (bud load) on T.S.S/acid ratio were almost similar to that of T.S.S percentage.

Similar results was found by El-Hammady and Abdel-Hamid (1995) who reported that vines moderate bud load 30 or 40 buds/vine had significantly higher T.S.S % than 50 or 60 buds/vine of ruby seedless grapevines.

Concerning total acidity % the results in the same table clearly showed a significant increase in total acidity % as bud load increase. Bud load of 98 or 105 buds/vine gave a total acidity % (0.563 & 0.531 and 0.543 & 0.523%) in the two seasons, respectively. Their findings are in harmony

with those obtained by Marward *et al*. (1993) and Rizk (1996) on Thompson seedless grape cultivars.

Table 5. Effect of bud load on chemical characteristics of berries of "superior" grapevines.

Treatments (Bud load / vine)	T.S.S. (%)		Total acidity (%)		T.S.S. / Acid ratio	
	2006	2007	2006	2007	2006	2007
77 Bud / vine	16.10	16.33	0.660	0.648	24.39	25.20
84 Bud / vine	16.52	16.68	0.633	0.620	26.09	26.90
91 Bud / vine	16.99	17.11	0.591	0.584	28.75	29.29
98 Bud / vine	17.82	17.93	0.563	0.531	31.65	33.77
105 Bud / vine	18.12	18.36	0.543	0.523	33.37	35.11
112 Bud / vine	16.50	16.63	0.650	0.651	25.38	25.55
119 Bud / vine	16.33	15.93	0.683	0.663	23.91	24.03
New L.S.D. at 5%	1.6	1.3	0.180	0.016	6.50	7.20

6- Wood ripening and Total carbohydrates

Data in Table (6) indicated that wood ripening significantly decreased as bud load increased. It is obvious that the high bud load of 112 or 119 buds/vine had always the lowest values in this respect were recorded (0.63 & 0.65 and 0.61 & 0.63) in the two seasons respectively. However bud load of 98 or 105 buds/vine gave higher values of wood ripening which recorded (0.78 & 0.79 and 0.79 & 0.80) in both seasons, respectively. The obtained data go in line with those reported by Fawzi *et al*. (1984); Rizk *et al*. (1994), Rizk (1996), Ali *et al*. (2000) and Omar & Abdel-Kami (2000).

Concerning the effect of bud load/vine on total carbohydrates. It is obvious from Table (6) that the effect of the different used treatments (bud load) on wood ripening were almost similar to that of total carbohydrates results.

Table 6. Effect of bud load on wood ripening and total carbohydrates (%) of "superior" grapevines.

Treatments (Bud load / vine)	Wood ripening coefficient		Total carbohydrates (g/100g dry weight)	
	2006	2007	2006	2007
77 Bud / vine	0.65	0.68	25.30	26.80
84 Bud / vine	0.69	0.71	28.16	28.63
91 Bud / vine	0.71	0.70	29.33	30.16
98 Bud / vine	0.78	0.79	30.11	32.33
105 Bud / vine	0.79	0.80	31.16	33.10
112 Bud / vine	0.63	0.65	26.30	27.305
119 Bud / vine	0.61	0.63	23.12	24.33
New L.S.D. at 5%	0.16	0.15	4.33	4.86

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