Effect of Bud Load on Bud Behavior, Yield, Cluster Characteristics and some Biochemical Contents of the Cane of Crimson Seedless Grapevines

[1]Fawzi M. I. F. [1]Shahin M. F. M. and [2]Kandil E. A.

[1]Pomology Department, National Research Center. [2]Horticulture Research Institute agriculture Research Center, Giza, Egypt

Abstract: This study was conducted through the seasons of 2007 and 2008 to determine the optimum bud loads/ vine for Crimson seedless "grapevines. Eight years old uniform vines were chosen and pruned to six different levels of bud load, namely 78, 91, 104, 117, 130 and 143 buds/ vine. Number of buds was fixed at 13 bud/cane. The results showed that the number of bursted buds was increased significantly by increasing bud load /vine in the two seasons of the study, while the percentage of bursted buds decreased. The bud fertility and fruitfulness were decreased by increasing bud load. Data also indicated that 104 or 117 buds/ vine were more suitable for Cirimson seedless grapevines to produce good yield and fruit quality. On the other hand, 78 or 143 buds/vine was unfavorable science it produced rather compact clusters. Increasing bud load increased number of cluster/vine and yield but reduced cluster weight. Vines pruned to 117 bud/vine gave the greatest cluster weight, length, rachis weight, berry weight, berry firmness, adherence, T.S.S and total sugars. Increasing bud load on the vine significantly increased total carbohydrates and protein contents of the canes during the dormant season. In this respect, vines pruned to 143 bud/vine showed higher percent of both total carbohydrate and protein contents than the other levels of bud load. [Journal of American Science. 2010;6(12):187-194]. (ISSN: 1545-1003).

Key words: Grapevine, winter pruning Crimson seedless, bud load, fruit quality.

1. Introduction:

Grape (Vitis vinifera. L.) is considered on of the most important fruits in the world. "Crimson seedless" is one of the new cultivars which were introduced to Egypt. It is a late - ripening cultivar with medium cluster in size (weight = 0.5kg; length 20cm) conical shaped with shoulders the cluster is well filled to slightly compact, the berries are medium in size 4.0g, 16.6mm in diameter (Ramming et. al., 1995) This cultivar holds significant promises for the Egyptian commercial producers and exporters due to its late maturity date as well as its seedless berries and the crispy texture of berries.

Pruning is considered the most important practice through which grape production can be increased and cluster quality improved. The basal 3-4 buds of the cultivar are less fruitful, so using long fruit canes is important for production normal crop.

Bud load is the most important factor affecting yield and cluster quality as well as vine vigor of Thompson seedless grapevines Morris and Cawthon (1980); Fawzi et at., 1984 ; Marwad et. al., (1993); Omar and Abdel-kawi, 2000; Rubio et al, (2002) on Tempranillo variety and El-Baz et. al; (2002) on Crimson seedless grapevines.

The objective of this study is to determine the optimum bud load per vine for Crimson seedless grape and to study the effect of bud load on bud behavior, cluster quality, yield per vine and total carbohydrates and proteins in the mature canes during the dormant season.

2. Materials and Methods:

This work was carried out in a private vineyard located beside the desert road of Alexandria - Cairo on 8 years - old Crimson seedless grapevines. This study extended for two successive years (2007 and 2008) the vines were grown 1.5 X4.0 meters apart in sandy soil under drip irrigation and trained according to cane pruning under, (Gable) trellis system. At pruning time (at winter) seventy two vines of almost similar vigor were selected and pruning to different bud load levels with fixed the length of canes at 13 bud/cane. The vines received the usual and recommended agriculture practices

The experimental treatments applied were as follows:

T1 - 6 canes X 13 bud/cane = 78 buds
T2- 7 canes X 13 bud /cane = 91 buds
T3- 8 canes X 13 bud /cane = 104 buds
T4- 9 canes X 13 bud /cane = 117 buds
T5- 10 canes X 13 bud /cane = 130 buds
T6- 11 canes X 13 bud /cane = 143 buds

In addition to the renewal spur (2 bud) per each cane. Each treatment contained three replicate of four vines per each. The randomized complete block

design was carried out. The following parameters were investigated for each experimental vine.

Bud behavior:

During the spring of each season number of bursted bud and fruitful buds were counted, then the percentages of bud burst, fertility and fruitfulness were calculated according to Bessis (1960) Bud burst % (number of bursted buds divided by total number of bud, per vine X 100); Bud fertility % (number of cluster per vine divided by total number of bud per vine X 100) and Fruitfulness % (number of fruitful buds dividing by number of bursted buds X 100). Also, numbers of clusters per vine were counted.

Yield / vine:

Average yield / vine was determined an average of number of clusters / vine and average weight of cluster / vine in kilograms at harvesting date (first - October) when average T.S.S % in berry juice reached about 19-20% according to Ramming et al., (1995) and Samra (1998).

Representative samples per each replicate were harvested and taken to laboratory to determine the following characters:

Physical characteristics of clusters:

Average of: cluster weight (g); rachis weight (g); cluster length (cm); number of berries/ cluster; cluster index (Av cluster weight divided by Av. weight of rachis/ cluster); compactness coefficient ratio (Av. number of berries/ cluster divided by Av. cluster length (cm)) according to Winkler (1962).

Physical characteristics of berries:

Samples of 100 berries from each replicate were collected at random to determine an average of berry weight (g); berry index (Av. number of berries presented in 100 gm of cluster); berry firmness and adherence by using push-pull (Dynahometer Model DT 101).

Chemical characteristics of berries:

Berry Juice was extracted and filtered through two Layers of cheese cloth to determine: total soluble solids percentage using a hand refractometer and acidity by titrating 10 ml juice sample against. NaoH (0.1 N).

Acidity was expressed as g tartaric acid/ 100 ml juice according to A.O.A.C. (1980); T.S.S / acid ratio was calculated and total sugar (Smith et al., 1956).

Determination of total carbohydrates and proteins in the canes:

At winter pruning sample of ripened canes were collected and used for determination:

Total carbohydrates were determined according to methods of Pulmmer, (1971). The obtained results of total carbohydrates were presented as g/100 J dry weight.

Total proteins were extracted in solution of 10% S.D.S, 1% mercaptoethanol, 65 ml tris/ Hcl, PH 6.8 as described by Dure & Chlan (1981) and Oster et al., (1981). Protein content was determined spectrophotometrically at 595nm according to Bradford (1976) and results were expressed as g/ 100 g dry weight of the canes.

The obtained data were tabulated and statistically analyzed according to Mead et al. (1993) using the new L.S.D at 5% parameter to compare the differences between various treatments.

3. Results and Discussion:

Bud behaviour:

From table (1) it is clear that the number bursted bud was increased significantly by increasing the number of bud load/ vine in the two seasons 2007 and 2008; The highest value was (102.33 & 103.10) for T6 i.e (143 buds/vine) in the two seasons respectively. On the other hand increasing bud load/vine significantly decreased bud burst percentage.

The highest bud burst percentage was associated with the lower bud load 78 and 91 buds/vine. The same results were obtained by Christensen et al., (1994) and Omar& Abdel - kawi (2000) showed that increasing bud load induced lower percentage of bud burst.

In addition, Ramming et al., (1995) reported that pruned Crimson seedless as a spur pruning produced a lower number of shoot/vine compared with the cane pruning. Thus vines pruned to 10 canes resulted in a significant higher number of shoots from canes than those were 6 or 8 canes/vine. Since vines with 6 canes gave a lower number of shoots/ vine.

As regarded percentages of bud fertility and fruitfulness, it is clear from the same table that percentage of bud fertility and fruitfulness were affected by bud load/ vine in this respect, the highest values were (38.32 & 37.32%) for TI (78 bud) per vine in the two seasons, respectively. Thus, vines pruned to (143 buds)/ vine gave lower bud fertility it recorded (28.83 & 29.48%) at the two seasons 2007 and 2008 respectively.

Concerning the data of fruitfulness vines pruned to (78 buds)/vine were the highest, while, vines pruned to (143 buds)/ vine were the lowest one. The obtained data go in line with those reported by Morris and Couthon (1980) they reported that vines with 30 or 60 buds/ per vine produced a higher estimated fruitfulness than that of 90 buds per vine. Recently Salem et al., (1997) mentioned that when Thompson seedless grapevine were pruned to 72, 84, 96, 108

buds per vine, leaving 96 or 108 buds produced the greatest growth and the lowest percentage of fruitful buds. The low fruitfulness of Crimson seedless grape was due to the high vigor vine, whereas moderated vigor it is usually more fruitful. According to the foregoing results, it could be conclude that Crimson seedless grapevines, which have high growth, get low fruitfulness, whereas the moderated vigor ones are usually more fruitful.

Number of clusters and yield/vine

Data of table (2) clearly indicated that number of cluster/vine were increased significantly as bud load was increased. It is obvious that treatment of (143 buds) / vine gave the highest number of clusters/ vine; it recorded (41.23 & 42.16) in the two seasons, respectively. Whereas leaving (78 buds)/ vine gave a lower significantly number of cluster which recorded (28.33 & 29.11) in both seasons, respectively. Yet, there are no clear differences on the number of clusters that had been obtained by leaving 117 buds or 130 buds/ vine. Similar results ware observed by Omar and Abdel-kawi (2000).

From the same table showed that the yield/ vine was significantly increased by increasing bud load. Moreover, the highest yield/ vine was obtained by those vine pruned to 104 buds & 117 buds/ vine which recorded (13.25 & 13.57kg/ vine) and (15.28 & 16.14kg/ vine in the two seasons, respectively. This increment in vine yield may be attributed increase in both number of clusters/ vine and their weight.

These results in this connection agree with those obtained by Ali, et al., (2000) and Omar & Abdel-kawi (2000) on Thompson seedless grapevines.

Physical characteristics of clusters.

Data in table (3) indicated that increasing the bud load/ vine reduced the average weight of cluster, thus, average cluster weight was least in vines pruned to 143 buds/ vine. Furthermore, leaving 104 buds or 117 buds/vine gave a slight increase in average cluster weight, without significantly differences amonge them. These results agreed with those findings of Omar & Abdel-kawi (2000) who reported that number of bunches per vine increased significantly by increasing the bud load per vine of Thompson seedless, but bunch weight decreased by increasing bud load.

Regarding rachis weight and cluster length data presented in Table (3) indicated that the effect of the different used treatment on rachis weight and cluster length were almost to that of cluster weight.

It is clear from Table (3) generally that the number of berries/ cluster of Crimson seedless grape was found to range between 81.34 – 103.05

These results in this respect are harmony with the findings found of El-Buz et. al., (2002) who that the number of berries/ cluster of Crimson seedless grape was found to range between 98 - 10 7.5. It is also clear from table (3) that clusters compactness values were highest in vine pruned to 91 ar 143 buds/vine. However, vines pruned to 104 as 117 buds/vine had recorded the lowest values of cluster compactness it recorded (3.03 & 3.54) and 3.89 & 3.64) in the two seasons, respectively. This means that bud load of 104 ar 117 buds/vine is stubble for Crimson seedless grape vines to good yield and slight compactness of cluster Moreover, Ramming et al., (1995) and Pommer et al. (1990) mentioned that cluster of Crimson seedless are medium in length and therefore are slight compact.

Concerning cluster index, it is clear from Table (3) that the highest values was found for vines pruned to 78 buds/vine it recorded (38.17 and 38.29) in the two seasons, respectively this increase could be attributed to the increases in fruit setting at this treatment (Marwad et. al., (1993); Rizk et al., 1994; Rizk, 1996 and Ali et al., 2000).

Physical characteristics of berries:

Data of table (4) revealed that the highest values of berry weight was obtained by vines pruned to 117 buds/ vine in the two seasons it is recorded (4-10 & 4.30g), respectively, This increase in berry weight was due to the increase of the cluster weight to the same treatment. (Abdel -Fattah, et al., 1993 and Rizk, (1996) and Ali, et al., 2000).

As for berry index it is clear from table (4) that the highest value was found for vines to 78 buds or 143 buds / vine, Data recorded (28.14 & 27.75 and 28.51 & 28.52) in the two seasons 2007 and 2008, respectively.

Table (4) showed that berry firmness of Crimson seedless grape was higher than berry adherence under different bud loads/ vine. Also, vines pruned to 117 buds / vine inhibited a slight effect on both berry firmness and adherence. No significant differences were noticed in berry firmness and adherence between vines pruned 78 buds were obtained by El-Baz et al., (2002).

Chemical characteristics of berries:

From table (5) it is clear that vines pruned to 117 buds/vine gave the highest significant values concerning T.S.S %, This treatment recorded (22.10 & 23.30%) during 2007 and 2008 seasons, respectively. Vines pruned to 104 buds/vine to the second rank. Vines pruned to 78 buds / vine gave the lower values, in this respect which recorded (19.50& 19.83 %) in the two seasons, respectively. The results agreed with those findings of Omar and Abdel -kawi (2000) who reported that increasing bud loads up to 72 buds/ vine

significantly increased berry T.S.S%, and leaving 48 or 120 buds/ vine recorded lower T.S.S % with no significantly differences with them. Similar results was found by Howell et al., (1991) Abdel - Fattah et al., (1993), Marwad (1993); Rizk, (1996) and Howell & Strieglar (1998) who reported a significant increase in T.S.S with pruning vines to short compared with long cane pruning. On the contrary, Ramming (1995) indicated that T.S.S% was not affected markedly by pruning levels of Crimson seedless. As shown table (5) it is evident that acidity % was increased by increasing bud load/vine. Vines pruned to 143 buds/ vine recorded the highest values of acidity % where it was (0.50 & 0.53%) in the two seasons, respectively. In this respect, El-Baz et al., (2002) found that leaving to 10 canes/ vine gave a slight increment of acidity % in berry juice than above that maintained on leaving 8 canes/ vine but the differences between them were not significant. Yet, vines pruned to 8 canes with 12 nodes produced a lower total acidity % than the other pruning severity of Crimson seedless grapevines. Badr (1997) reported that titratable acidity of crimson seedless was not affect markedly either under cane are spur pruning Also, Ramming et al. (1995) mentioned that, pruning levels gave no clear effect on the titratable acidity of berry jucie of Crimson seedless.

It is clear from Table (5) that the effect bud load /vine on T.S.S/ acid ratio similar to that concerning in total soluble solids.

The same table indicated that total suger decreased by increasing bud load/vine. The least values was found in vines pruned to 143 buds/ vine. It recorded (15.36 and % 15.33) in the two seasons, respectively. However total sugar % was higher in vines pruned to 117 buds / vine which recorded (17.59 and 17.98 %) in the both seasons, respectively. The obtained data are similar to that obtained of Tafazol (1977) who found that a decrease in fruit sugar content by increasing the number of buds / vine.

Total carbohydrates and proteins content in the canes.

Data in table (6) indicated that total carbohydrates content in the cane at dormant period was significantly increased by increasing bud load/vine. In this connection, vines which were pruned to 143 buds /vine appeared to assimilate and store higher carbohydrates content than the other ones pruned to 78 buds/ vine, which was recorded a lower carbohydrates content during the two seasons, of the investigation. This is not strange since this treatment produced a lower number of subsequent shoots compared with the treatment having higher bud load 143 buds / vine which in turn produces higher number of shoot. Our results in this connection agree with those obtained by kliewer (1981) and Gao & Cahoon (1994) who reported that increasing leaves lead to heavy canopy with increase in active photosynthesis and stored carbohydrates in the new canes. Similar results were obtained by Omar & Abdel-kawi (2000) on Thompson seedless grapevines and El-Baz et al; (2002) on Crimson seedless grapevines.

Data of table (6) show the effect of different bud load/ vine on total protein content in the cane of Crimson seedless grape during dormant season. Thus it is appeared to increase by increasing the bud load on the vine. In this respect, vines which were pruned to 78 buds/ vine maintained the lowest content of total protein in their canes during the both seasons of this study. These results in agreement with El-Baz et al; (2002) on Crimson seedless grapevines.

Table (1) Effect of bud load on bud behaviour of "Crimson seedless" grapevines in 2007 and 2008 seasons

Treatments (Bud load per vine)	Number of bud burst		Bursted buds (%)		Fertitity buds (%)		Fruitfulness (%)	
	2007	2008	2007	2008	2007	2008	2007	2008
T1 - (78 bud)	62.31	63.12	79.88	80.92	36.32	37.32	45.47	46.12
T2 - (91 bud)	71.30	72.10	78.35	79.23	33.09	34.32	42.23	43.31
T3 - (104 bud)	80.59	79.30	77.49	76.25	31.98	33.75	41.27	44.26
T4 - (117 bud)	88.33	90.11	79.77	82.05	32.62	33.53	43.20	43.53
T5 - (130 bud)	95.10	101.31	73.15	77.93	30.08	3.079	41.13	40.79
T6 - (143 bud)	102.33	103.10	71.56	72.09	28.83	29.48	40.29	40.89
New L.S.D at 5%	6.3	5.6	2.6	2.5	0.61	0.63	0.86	0.88

Table (2) Effect of bud load on number of cluster per vine and yield of "Crimson seedless" grapevines in 2007 and 2008 seasons

Treatments (Bud load par vine)	Number of cluster/ vine		Yield (kg)/ vine	
	2007	2008	2007	2008
T1 - (78 bud)	28.33	29.11	10.09	10.57
T2 - (91 bud)	30.11	31.23	11.30	12.03
T3 - (104 bud)	33.26	35.10	13.25	13.57
T4 - (117 bud)	38.16	39.23	15.28	16.14
T5 - (130 bud)	39.11	41.33	12.52	13.64
T6 - (143 bud)	41.23	42.16	11.76	12.28
New L.S.D at 5%	0.73	0.92	1.23	1.31

Table (3) Effect of bud load on some cluster characteristics of Crimson seedless grapevines in 2007 and 2008 seasons

Treatments (Bud load per vine)	Cluster weight (g)		Rachis weight (g)		Cluster length (cm)		No. of berries/ cluster		Compactness coefficient		Cluster index	
	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
T1 - (78 bud)	356.16	363.00	9..33	9.48	23.16	23.51	100.24	100.72	4.33	4.28	38.17	38.29
T2 - (91 bud)	375.33	385.23	11.63	11.16	23.18	23.61	102.16	103.05	4.41	4.65	32.27	34.52
T3 - (104 bud)	398.23	391.26	12.93	13.10	25.18	26.10	101.59	92.28	3.03	3.54	30.79	29.87
T4 - (117 bud)	400.30	411.33	13.16	13.58	25.10	26.31	97.63	95.66	3.89	3.64	30.42	30.29
T5 - (130 bud)	320.16	330.11	12.53	12.93	19.30	18.93	85.45	83.91	4.27	4.33	25.55	25.53
T6 - (143 bud)	285.30	291.16	10.36	10.50	18.33	18.53	81.34	83.08	4.38	4.86	27.54	27.74
New L.S.D at 5%	25.23	26.16	0.81	0.92	2.10	2.51	9.25	8.16	0.16	0.15	2.60	2.70

Table (4) Effect of bud load on some berry characteristics of Crimson seedless grapevines in 2007 and 2008 seasons

Treatments (Bud load per vine)	Berry weight (g)		Berry Index		Berry firmness g/cm		Berry adherence (g)	
	2007	2008	2007	2008	2007	2008	2007	2008
T1 - (78 bud)	3.46	3.51	28.14	27.75	923.10	936.33	699.10	701.33
T2 - (91 bud)	3.56	3.63	27.22	26.75	952.16	958.10	735.33	738.11

T3 - (104 bud)	3.92	4.10	25.50	23.59	954.33	963.18	771.23	778.23
T4 - (117 bud)	4.10	4.30	24.39	23.26	999.30	1003.16	789.16	792.11
T5 - (130 bud)	3.60	3.78	26.39	25.42	968.16	973.11	761.33	750.31
T6 - (143 bud)	3.38	3.35	28.51	28.57	918.31	910.33	700.30	689.33
New L.S.D at 5%	0.23	0.26	2.00	3.3	35.63	36.16	28.33	29.16

Table (5) Effect of bud load on chemical of berries of crimson seedless grapevines in 2007 and 2008 seasons

Treatments (Bud load Per vine)	T.S.S. (%)		Acidity (%)		T.S.S./ acid ratio		Total sugar (%)	
	2007	2008	2007	2008	2007	2008	2007	2008
T1 - (78 bud)	19.50	19.83	0.44	0.45	44.32	44.07	17.10	17.53
T2 - (91 bud)	20.11	20.50	0.44	0.46	45.70	44.57	17.41	17.10
T3 - (104 bud)	21.98	23.10	0.46	0.48	47.78	48.13	17.50	17.90
T4 - (117 bud)	22.10	23.30	0.42	0.45	52.62	51.78	17.59	17.98
T5 - (130 bud)	19.23	19.56	0.48	0.50	40.06	39.12	15.13	16.33
T6 - (143 bud)	19.23	19.50	0.50	0.53	38.46	36.79	15.30	15.33
New L.S.D at 5%	2.23	2.36	0.03	0.05	6.81	7.32	1.31	1.63

Table (6) Effect of bud load on total carbohydrates and proteins in the canes of Crimson seedless grapevines in 2007 and 2008 seasons

Treatments (Bud load per vine)	Total carbohydrates (g/ 100g dry weight)		Total protein (g/ 100g dry weight)	
	2007	2008	2007	2008
T1 - (78 bud)	18.23	18.89	15.30	15.58
T2 - (91 bud)	19.98	20.11	15.90	15.93
T3 - (104 bud)	22.16	23.33	16.30	16.71
T4 - (117 bud)	23.30	24.11	16.33	16.83
T5 - (130 bud)	23.10	24.58	16.90	16.93
T6 - (143 bud)	24.33	25.33	17.10	17.54
New L.S.D at 5%	3.31	4.33	3.19	3.32

Corresponding author
Fawzi M. I. F.
Pomology Department, National Research Center, Giza, Egypt

4. References:

1. A.O.A. C (1980). Association of Official of Analytical Chemist 14th ed. Published by the A.O.A.C.P.O. Box 540, Washington, 4D. C., USA.
2. Abdel-Fattah S.E; Marwad, I. A; and Isis Abdel-shahied Rizk (1993). Effect of bud load and spur length on Roumi Red grapevine I-Weight of pruning and chemical compostion of 1 year - old wood. Zagazig.J. Agric. Res Vol 2.0 No. (6) pp 1889 -1899.
3. Ali, M. A., El-mogy, M.M and Rizk, I. (2000). Effect of cane length on bud behaviour, bunch characteristies, wood ripening and chemical contents of Thompson seedless grapevine Agric, sci., Mansoura Univ. 25 (3), pp1707-1717.
4. Badr, S.A. (1997). Cultural practres for new table varieties selection Research Report for California Table Grape Fresno, California, 13, 1.
5. Bessis, R. (1960). Sur differences Moder D expression quantive Dela fertile chez la vigna pp. 828-882.
6. Bradford, M.M. (1976). A rapid and sensitive method for quantitation of microgram quantities of protein utilizing the principle of protein dyebinding Analytical Biochemistry pp 72, 248.
7. Christensen, L. P. Leavit, G. M. and Bianch, M. L. (1994). The effects of pruning level and post bud break cane adjustment on Thompson seedless raisin production and quality, Amer. J. Enel and vatic., 45 (2), 141.
8. Dure, I. I. I and Chlan, C. (1981). Developmental bio- chemistry of cotton seed embryogenesis and germination XII. Purification and properties of principle storage protein. Plant physiol pp 68, 180.
9. El- El. T. El- Baz, A.M; Mansour, El- Dengway, El. F. and Samra, B.N. (2002). Influence of pruning seveity on bud behaviour, yield, berry quality and some biochemical contents of the canes of Crimson seedless grapes. Egypt . J. Hort. 29, (1), pp. 39-60.
10. Fawzi, F., Bondok, A.Z. and Ghobrial, G. F. (1984). Effect of cane length on bud behaviour and wood ripening of Thompson seedless grape variety, Annals Agric., Sci., Ain Shams Univ., Cairo 29 (1) 465-474.
11. Gao, Y. and Cahoon, G.A. (1994). Fruit quality, fruit skin colour, and anthocyanin content and composition in Reliance (*Vitis hybrid*) Vitis, 33, (4), pp 205.
12. Howell, G.C; David, P.M.; Charles, E.E. and R.Keith, S. (1991). Influence of training system and pruning severity on yield vine size, and fruit composition of Vignoles grapevines. Vol, 42, No. 3, pp. 191-197 Am. J. Enol. Vitic.
13. Howell, G.S and strieglar, K. (1998). Pruning grapevines in Michigan Hort. Extension Bull; Michigan State Univ. Bull. 25, 1.
14. Kliewer, W.M (1981). Grapevine physiology; How does grapevine make sugar leaflet No. 21231. Cooperative Extension Us Department of Agric, California Univ.
15. Marwad, I. A.; Rizk, N. A and Ibrahim, A. H (1993). Effect of cane length on bud behaviour, Yield, bunch characteristics and wood maturity of Thompson seedless grapevines Egypt. J. Appl. Sci., 8 (12) pp 47-60.
16. Mead, R., Curnow, R. N. and Harted, A. M. (1993). Statistical methods in Agricultural and Experimental Biology. 2nd Ed. Chapman & Hall, London.
17. Morris, J. R and Cawthon, D.L. (1980). Yield and quality response, of Concord grapes to training system and pruning seveity in Arkansas. J. Am. Soc. Hort. Sci. 105: pp 307-310.
18. Omar, A.H and Abdel- kawi, A. (2000). Optimal bud load for Thompson seedless grapevines. J. Agric Sci. Mansoura Univ. 25 (9), pp5769-5777.
19. Oster, V., Kardinal, C., Brghardt, H., Lottspeich, F. and Rudiger, W. (1992). Natural inhibitors of germination and growth. J. plant Physiol. 140, pp 110.
20. Plummer, D. T. (1971). An introduction to practical biochemistry McGraw-Hill Book company (UK) limited. Maidenhead. Berkshire England.
21. Pommer, C.V., Terra, M.M., pires, E.I.P; Passos, I.R.S. and Martins, V.P. (1999). Introduction of the table grape cultivar Fantasy seedless and Crimson seedless in Brazil. Scientia Agric. 56 (1), pp 247.
22. Ramming, D.W., Roland, T. and Badr, S.A. (1995). Crimson seedless: A new late maturity, Red seedless grape. Hort Sci. 30 (7): pp1473 - 1474.
23. Rizk, N.A.; Fizk, I. A, and Grigis, V.H. (1994). Effect of cane length on bud behavior, wood ripening and bunch characteristics of Thompson

seedless grape Egypt. Jour. Appl. Zagazig Univ. Sci, 9 (5) 230-239.

24. Rizk. A. I (1996). Effect of cane length on bud behaviour and bunch characteristics in Thompson seedless grape cultivar. Egypt. J. App Sci; 11 (7): 220-234.
25. Rubio, J.A., Albuquerque M. V., peixy, J.L and yuste . J. (2002). la mejora varietal de la vid, sus consescuencias y beneficios. Vida Rural, pp 149: pp 62-66.
26. Salem, A.T, kilani, A.S and shaker, G.S. (1997). Growth and quality of two grapevine cultivars as affected by pruning severity. Acta Hort. 441.309.
27. Samra, N. R. (1998). Evaluation of table grape cultivars behaviour and training system in Egypt and California. Report for Egypt project of Agricultural Technology Utilization and transfer project (ATUT) pp. 55-58.
28. Smith, F.; M. A. Gilles; j.k Hamilton and Godes, P.A. (1956) .Colorimetric methods for determination of sugar and related substance. Annal., Chem., 28, pp 350-356.
29. Tafazoli, E. (1977). Cane and bud number effect on yield components of non-irrigated grape cv. "Yaghooti. Scientia Horticultura 7 (2): pp133-136 (Hort. Abst., 48 No. 259).
30. WinKler, A. J. (1962). General Viticulture Univ. of California. Press, pp, 135-255, USA.

7/3/2010