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BUD FERTILITY, GROWTH, YIELD AND FRUIT QUALITY OF THOMPSON SEEDLESS GRAPEVINE AS AFFECTED BY SOME FIELD PRACTICES

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ABSTRACT

Percent of bud fertility, growth and fruiting of Thompson Seedless grapevines in response to foliar application with GA_3, urea and potassium sulphate were studied during 2001 and 2002 seasons.

Results showed that bud fertility % was minimized in vines when sprayed with GA_3 and/or urea, while maximized in vines sprayed with potassium sulphate. Growth parameters were greatly promoted by GA_3, urea and potassium sulphate together. Wood ripening was maximized in vines sprayed with potassium sulphate.

Yet, this treatments had no considerable effect on number of clusters/vine, while obviously improved the yield (kg) compared with the control. Weight and dimensions of cluster and berry were positively affected by foliar application of GA_3, urea and potassium sulphate. Application with GA_3 and potassium sulphate were responsible for obtaining unfavorable and favorable effects on berry quality. The maximum total carbohydrates was recorded in vines sprayed with potassium sulphate and urea.

Thus, spraying Thompson seedless grapevines twice with GA_3, urea and potassium sulphate were considered of promising treatment.

INTRODUCTION

Nitrogen and potassium applications play an essential role in nutrition of grapevines. Bud fertility, growth and fruiting of grapevines are markedly influenced by lack of N and K than other elements. Nitrogen and potassium are greatly lost through leaching in vineyards under surface irrigation system. This fact is very important from the point of fruit nutrition and is necessary for finding out a nutrient solution through foliar application. Foliar method is an excellent supplement compared to soil application particularly for quick curing of nutrients deficiency (Nijjar, 1985).

During initiation, differentiation, and bud burst in various grapevines CVS, the formation of productive inflorescences is very sensible to many unfavorable conditions and malnutritional factors which lead to produce bad yield. Evidence has been reported that growth substances especially GA_3 partially plays a factor causes an obvious reduction on bud fertility and improved berry development and fruiting (Weaver, 1972 and Jacobs 1997).

Supplying various grapevine CVS with urea via foliage was accompanied by reducing bud fruitfulness and enhancing growth and fruiting especially in the following season after application (El_Shamy and Haggag, 1987, El_Morsy *et al.,* 1993, 1996 and 1996b, and Omar, 2003). Similar positive effects were detected when vines were sprayed with potassium sulphate (Abd _Elal, 1991, Ahmed and El_dawwey, 1992, Mahmoud, 1993, and Gobara 1999).

Application of GA_3 in vineyards was found to induce various negative effects on bud fertility and positive effects on growth and fruiting. The promising effect of GA_3 was concerned with flower abscission and enhancing fruit development. (Weaver, 1972; El_Nabawy *et al.*, 1987; Singh *el al.*,1979; Lavin, 1983; Serralheiro, 1984; Badawi *et al.*, 1984; Thilak, 1985; Ahmed, 1988; El_Gahy, 1990 and Khalil and Abd El_fattah, 1993).

This study aimed to examine the effect of spraying urea, potassium sulphate and GA_3 alone or in combination on bud fertility, growth and fruiting of Thompson Seedless grapevines.

MATERIALS AND METHODS

This experiment was carried out during two successive seasons of 2001 and 2002 in a private vineyard located at Basandela village near El_Mansoura city, Dakahlia governorate. Twenty Thompson Seedless grapevines 12-years old approximately uniform in growth are chosen. The vines were subjected to cane pruning on three wires system, and planted in clay loam soil at 1.5 x 2.5 m apart. Using vines were pruned at the first week of January in both seasons leaving five canes with 12 eyes along with five renewal spurs with two buds (with a total vine load 70 nodes/vine). Using surface irrigation system was followed in the vineyard. Soil analysis was carried out according to methods described by Wild *et al.* (1985) and the obtained data are shown in Table (1).

Table (1): Mechanical, Physical and Chemical analysis of the soil.

Sand	17.6
Silt	57.6
Clay	24.8
Texture	Clay loam
E. C. (mmhos/1cm/ 25°c)	0.23
Anions meq/100 g soil	
Hco3	0.86
Cl	0.20
So4	0.40
Catiom meq/100 g soil	
Ca	0.47
Mg	0.27
Na	0.63
K	0.09

The experiment included the following treatments:

1- Control.
2- GA_3 20 ppm foliar application.
3- Urea 1.0 % foliar application.
4- Potassium sulphate 2 % foliar application.
5- GA_3 + urea foliar application.
6- GA_3 + potassium sulphate foliar application.
7- Urea + potassium sulphate foliar application.
8- GA_3 + Urea + potassium sulphate foliar application.

Each treatment was replicated three times, five vines per each one. Urea and potassium sulphate were sprayed twice when the length of inflorescence was 5-8 cm and again when the berry diameter reached 3-4 mm. GA_3 was sprayed twice at 20 and 40 ppm, in the same former dates respectively till runoff. Triton B as a wetting agent was added at 0.05% to solutions. Randomized complete block design was used. All the chosen vines received the common cultural management as usual.

Table (2) : Effect of foliar application of G A_3 Urea and Potassium sulphate on the percentage of well developed infrolescence primordia in buds at different nodes position in Thompson seedlees grapevines (season 2001)

Position of bud on cane. / Treatments	1	2	3	4	5	6	7	8	9	10	11	12
Control	3	9	18	23	36	50	73	74	66	64	55	41
GA_3	1.5	7	15	19	30	42	67	66	61	54	47	36
U	2	7.5	16.5	20.5	33	45	70	71	63	57	51	38
K	5	12.5	24	34	45	61	80	81	72	69	59	46
GA_3+U	0	6	13	17.5	27	40.5	62	61	59	52	44	34
GA_3+K	3	10	19	25	36.5	53	75.5	75	68	64.5	53	40
U+K	4	10	20	30	41	59	78	78	70	66	56	44.5
GA_3+U+K	3.5	11	22	26	39	54	78	76	67	67	54	42.5

U = urea K = Potassium sulphate

Table (3) : Effect of foliar application of G A_3, Urea and Potassium sulphate on the well developed infrolescence primordia in buds at different node positions in Thompson seedlees grapevines (season 2002)

Position of bud on cane. / Treatments	1	2	3	4	5	6	7	8	9	10	11	12
Control	2	7	17	24	34	53	71	73	70	61	54	41
GA_3	0	6.5	13	19	28	42	63	66	62	52	49	34
U	1	7	14	21	30	42	66	69	64	54	51	38
K	4	9	23	32	43	61	79	79.5	76	68	60	47
GA_3+U	0	6	12.5	18	25	40	62	63	59	50	49	34
GA_3+K	1.5	7.5	18	25	36	55	72	75.5	65	55	52	39
U+K	3	8	19	28	36.5	57	77	76	73	59.5	54.5	43
GA_3+U+K	1.5	8.5	21	27	38	59	78	77	72	62	55	44

1- Determination of bud fertility:

After leaf drop (Late of November), a sample of 72 canes were selected, each cane had 12 buds.

Buds were dissected and examined under binocular microscope to ascertain the percentage of buds containing well developed inflorescence primordia at each node according to methods described by Mbika and pandey (1969).

2- Growth vigour:

After growth start, five shoots were labeled, for measuring length and thickness of main shoot at growth cessation of each season. Wood ripening coefficient was calculated before pruning by dividing the length of brownish parts by total length of the shoot and multiplying the product by 100. After pruning, weight of removal one year old wood was estimated in kg/vine.

3-Total carbohydrates in the canes:

It was determined on dry weight basis according to methods outlined by Peach and Tracey(1968).

4-Yield and berry quality:

Yield weight, cluster weight, and number of clusters/vine were recorded at harvest time when total soluble solids of the untreated vines reached 16-18% (according to El-Banna, 1968). Five clusters/vine were taken at random for determination of weight and volume of 100 berries, dimension of both cluster and berry (length and width), total soluble solids, total sugar and total acidity (as g. tartaric acid/100 m juice) according to A. O. A. C. (1985). The ratio between total soluble solids % and total acidity was estimated.

RESULTS AND DISCUSSION

1. Bud fertility

Data in Fig (1 & 2) shows clearly that bud fertility was greatly varied among node positions. Since it increased gradually from the bud number one upward to bud 8, then percentage of buds containing well developed inflorescence primerdia tend to reduce from bud 9 to bud 12. It could be estated t hat t he m aximum b ud f ertility was progressively recorded on buds located a t n ode N o. 8 with few exceptions, while buds at node 12 had the lowest fertility.

Foliar applications with GA_3, urea and potassium sulphate either alone or combined had a pronounced effect on bud fertility % compared to the control. Single or combined application with urea & GA_3 was accompanied with a reduction in the percentage of bud fertility compared to potassium alone or with GA_3 and urea and control treatment in all node positions. However, spraying potassium sulphate either single or in combinations with GA_3 or urea was effective in enhancing bud fertility % compared to other treatments. It is clear from these results that potassium sulphate application was very effective in counteracting the adverse effects of GA_3 and urea on bud fertility %. Since, spraying potassium sulphate at 2.0% alone is considered to be a striking treatment in this connection, followed by application of urea + potassium sulphate in most node positions. Spraying Thompson Seedless grapevines with 2.0% potassium sulphate raised the percentage of bud fertility along all n odes o vercoming a ll o ther t reatments, particullaly at the eighth position which reached 81.0 and 79.5% in both seasons r espectively. T he m inimal v alues w ere detected on vines received GA_3 and urea together. The reduction in bud fertility to application with GA_3 might be attributed to the high dropping of clusters as well as the effect of GA_3 on promoting the growth of tendrils and encouraging the transformation of inflorescences to tendrils or tendril-like structure.(Srinivasan and Mulina, 1980 and Chinnathambi and Mulina, 1981). The great promotion of the synthesis of anlagen compound which stimulate growth of tendrils in response to application of GA_3 could add another explanation. Similar effect of urea is mainly attributed to its effect on enhancing growth and exhausting most organic and mineral nutrients in unfavour of producing productive buds. The adverse effects of spraying urea on producing unbalanced ratio between total carbohydrates and total nitrogen could explain the present results. The positive action of potassium on bud fertility is mainly ascribed to its effect in enhancing the biosynthesis and transportation of carbohydrates and result a good balance between it and total N. In addition, the opposite effect of K and anlagen formation and tendril growth will lead to promote inflorescence formation.

Figure (1): Effect of GA3, Urea and Potassium Sulphate on the Percentage of buds containing well developed infrolescence primordia at different node positions in Thompson Seedless at 2001 season.

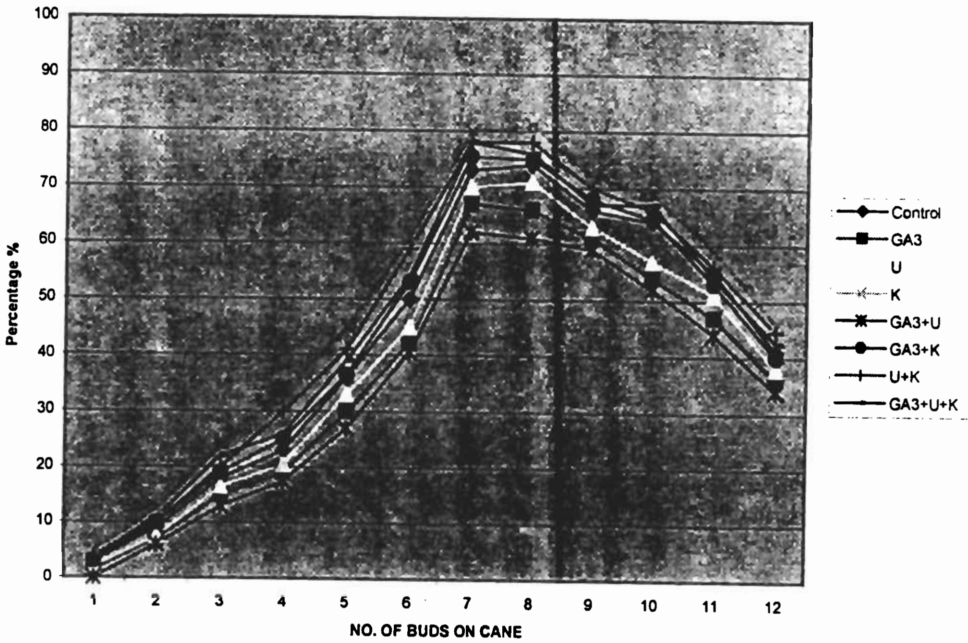
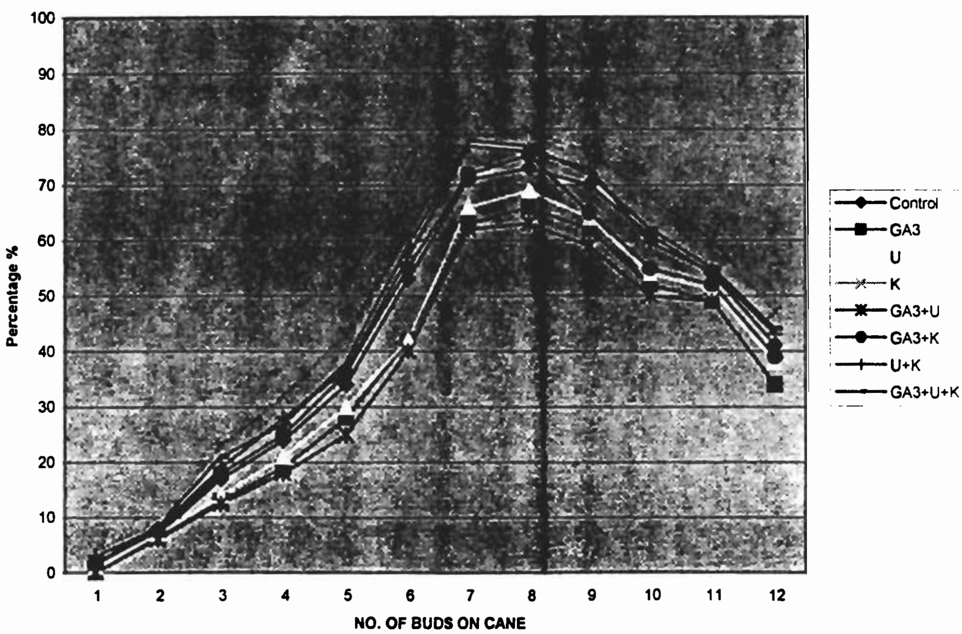


Figure (2): Effect of GA3, Urea and Potassium Sulphate on the Percentage of buds containing well developed infrolescence primordia at different node positions in Thompson Seedless at 2002 season.



The effect of K on balancing growth with flowering surely reflected on enhancing flower initiation (Chinnethanbi and mullina, 1981) These results are in harmony with those obtained by Weaver(1972), El-Nabawy *et al.* (1978); Khalil and Abd El-fattah (1993) on GA_3, and El-Shamy and Haggag (1987) on urea.

2. Growth vigour

It is clear from Tables(4&5) that single or combined application of GA_3, urea and potassium sulphate significantly stimulated growth parameters namely length and thickness of shoot and pruning weight compared to control treatment. Combined application with GA_3, urea and potassium sulphate double or triple applications was effective in stimulating growth characters than using each alone. The maximum values were detected on vines received two sprays with GA_3, urea and potassium sulphate together, so the untreated vines produced the minimum values in both seasons.

A synergistic response was noticed between GA_3 and K through the shoot length. The combined application of the two compounds include a significant great effect more than both of them alone.

Table(4): Effect of foliar application of GA3, urea and potassium sulphate on shoot length and thickness of Thompson Seedless grapevines (season 2001).

Treatments	Shoot length (cm)		Shoot thickness (cm)	
	2001	2002	2001	2002
Control	121.0	122.3	1.11	1.08
GA_3	145.7	148.0	1.25	1.24
U	138.0	140.0	1.30	1.30
K	130.0	131.0	1.27	1.26
GA_3+U	151.7	152.0	1.32	1.31
GA_3+K	148.3	151.3	1.24	1.29
U + K	145.0	148.3	1.32	1.33
GA_3+U+K	154.0	156.3	1.33	1.35
New-LSD at5 %	5.6	5.6	0.04	0.07
at 1%	8.1	7.8	0.05	0.10

GA_3 = Gibberellic acid, U= Urea, K= Potassium sulphate

Table(5): Effect of foliar application of GA3, urea and potassium sulphate on wood ripening and pruning weight of Thompson Seedless grapevines (season 2001 & 2002).

Treatments	Wood ripening (%)		Pruning weight (kg)	
	2001	2002	2001	2002
Control	89.3	88.3	1.112	1.127
GA_3	84.2	82.9	1.205	1.217
U	86.8	85.8	1.314	1.309
K	91.6	90.7	1.145	1.156
GA_3+U	82.7	82.0	1.327	1.324
GA_3+K	85.9	85.6	1.324	1.322
U + K	87.2	86.9	1.367	1.363
GA_3+U+K	86.0	85.4	1.396	1.399
New-LSD at5 %	1.6	1.2	0.071	0.045
at 1%	2.2	1.7	0.097	0.063

Similar effect was found between GA_3 Urea and between Urea and potassium in both seasons. Yet, the more sound effect was induced when the three compounds were applied together.

The effect of GA3 in enhancing cell division and cell enlargement was obtained by(Jacobs, 1979) and the effect of N and K in stimulating cell division and the biosynthesis and transportation of organic foods (Nijjar, 1985).

Similar results were obtained by Ahmed (1988) and El-Garhy (1990) on G A3, E l-Morsy *et al.* (1993), Akl *et al.*(1996a) and Omar(2003) on urea and Abd Elal (1991) and Gobara (1999) on potassium sulphate.

3. Wood ripening:

Percent of wood ripening was negatively affected by single or combined application of all compounds than control. Foliar application with potassium sulphate alone significantly increased wood ripening in both seasons.

The increment of growth due to using GA3 and urea could result a depleting in most mineral and organic foods. and delay wood ripening. However, the great accumulation of organic and mineral foods in response to application of K could explain the present results (Nijjar, 1985). These results are in harmony with those obtained by Jacobs (1979).

4. Yield:

Table (6) shows that number of clusters/vine in the seasons did not varied significantly among the studiy. Results reveal that single or combined application withGA3, urea and potassium sulphate were significantly increased yield compared to control. Application of the three compounds together succeeded in producing maximum yield. Since, under such promising treatment, yield reached 9.7 and 9.2 kg in both seasons. So the positive action of the studied compounds on cluster weight goes in the same direction of the yield.

These results are in harmony with those obtained by El-Nabawy *et al.* (1978), Badawi *et al.* (1984),Ahmed (1988) and El-Garhy (1990) on GA3, El-Morsy *et al.* (1993), Akl (1996b) and Omer (2003) on urea, and Mahmoud (1993) and Gobara (1999) on K.

Table(6): Effect of foliar application of GA3, urea and potassium sulphate on cluster number & weight and yield per vine of Thompson Seedless grapevines (season 2001 & 2002)

Treatments	Number of clusters/vine		Cluster weight (g)		Yield per vine (Kg)	
	2001	2002	2001	2002	2001	2002
Control	16.6	17.4	294.0	282.0	4.88	4.91
GA_3	17.3	18.1	416.0	421.0	7.19	7.61
U	18.1	17.2	401.0	403.0	7.26	6.93
K	17.0	16.3	332.0	352.0	5.60	5.73
GA_3+U	14.3	14.9	571.0	584.7	8.17	8.69
GA_3+K	17.4	18.0	444.0	446.7	7.73	8.05
U + K	18.4	17.1	400.0	411.0	7.36	7.01
GA_3+U+K	14.0	13.3	691.7	690.3	9.69	9.20
New-LSD at5 %			50.9	52.1	1.68	0.97
at 1%	NS	NS	70.6	72.1	2.19	1.33

Table(7): Effect of foliar application of GA3, urea and potassium sulphate on cluster length and width of Thompson Seedless grapevines (season 2001 & 2002).

Treatments	Cluster length (cm)		Cluster width (cm)	
	2001	2002	2001	2002
Control	20.00	19.33	11.00	11.33
GA_3	29.33	28.67	13.33	13.33
U	26.00	26.00	12.33	12.00
K	23.00	24.33	11.33	12.00
GA_3+U	31.00	32.00	13.67	13.67
GA_3+K	29.67	31.00	14.00	13.67
U + K	27.67	27.00	13.67	13.00
GA_3+U+K	35.00	34.00	14.67	15.00
New-LSD at5 %	3.34	3.57	1.78	
at 1%	4.55	4.87	2.33	NS

GA_3 = Gibberellic acid, U= Urea, K= Potassium sulphate

5. Cluster weight and dimensions:

It is evident from Tables (6&7) that single or combined application with GA_3, urea and potassium sulphate were increased both weight and dimensions of cluster compared to control in both seasons significantly. The former synergistic response which happened in shoot length, between GA_3, U and K were obtained again through cluster weight and length, and yield per vine.

The positive action of GA3, N, and K on berry weight and dimensions could explain the present results. These results are in accordance with those obtained by El-Nabawy *et al.* (1978), Ahmed (1988) and El-Garhy (1990) on GA3, Akl *et al.* (1996b) and Omer (2003) in urea and Ahmed and El-Dawwey (1992) and Gobara (1999) on K.

6. Quality of the berries:

Physical parameters namely weight, volume, length and diameter of berries were positively affected by single, or combined applications of GA3, urea and potassium sulphate compared to control. Application of GA3 alone produced the minimum values of total soluble solids %, total sugars and T. S.S./Acid ratio and the maximum values of total acidity % compared to the other treatments. The best results with regard to physical characteristics were obtained due to spraying GA3, urea and potassium sulphate together. Single application with potassium sulphate gave the better results with regard to chemical quality of the berries. Satisfactory promotion on physical and chemical parameters was detected when using the three compounds togrther in 2001 and 2002 seasons (Tables 8, 9, 10, and 11).

Delaying effect of GA3 and the advancing effect of urea and potassium sulphate on berry maturity could explain from the present results regarding chemical characteristics. The promotion on berry weight and dimensions in response to application of GA3 may be attributed to its effect in stimulating both cell division and cell enlargement (Jacobs, 1979). The improving effect of urea and potassium sulphate on berry weight and dimensions may be attributed to their important roles in stimulating cell division and the biosynthesis of organic foods (Nijjar, 1985).

Table(8): Effect of foliar application of GA3, urea and potassium sulphate on 100 berry weight and volume of Thompson Seedless grapevines (season 2001 & 2002).

Treatments	100-berry weight (g)		100-berry volume (cm^3)	
	2001	2002	2001	2002
Control	152.0	153.0	137.3	136.3
GA_3	205.7	202.0	182.0	183.0
U	187.0	189.7	151.0	151.7
K	168.3	171.7	142.0	144.0
GA_3+U	215.0	214.3	192.0	194.0
GA_3+K	208.7	211.7	182.7	187.0
U + K	198.7	200.0	180.3	177.3
GA_3+U+K	217.3	220.0	194.0	198.3
New-LSD at5 %	13.5	24.8	17.0	18.4
at 1%	18.4	34.3	23.2	25.1

Table(9): Effect of foliar application of GA3, urea and potassium sulphate on berry length and diameter of Thompson Seedless grapevines (season 2001 & 2002).

Treatments	Berry length (cm)		Berry diameter (cm)	
	2001	2002	2001	2002
Control	1.47	1.50	1.32	1.31
GA_3	1.80	1.85	1.49	1.48
U	1.78	1.79	1.43	1.43
K	1.60	1.60	1.37	1.36
GA_3+U	1.88	1.87	1.54	1.56
GA_3+K	1.75	1.80	1.47	1.50
U + K	1.70	1.73	1.40	1.41
GA_3+U+K	1.95	1.95	1.59	1.57
New-LSD at5 %	0.14	0.10	0.11	0.09
at 1%	0.20	0.14	0.15	0.12

Table(10): Effect of foliar application of GA3, urea and potassium sulphate total soluble sugars, acidity and TSS/acid ratio of Thompson seedless grapevines (season 2001 & 2002).

Treatments	TSS %		Acidity %		TSS/acid ratio	
	2001	2002	2001	2002	2001	2002
Control	17.0	17.2	0.609	0.600	27.90	28.67
GA_3	16.0	16.2	0.725	0.725	22.27	22.30
U	18.0	17.5	0.588	0.613	30.60	26.27
K	18.3	18.4	0.525	0.550	34.87	33.47
GA_3+U	16.3	16.3	0.663	0.688	24.57	27.07
GA_3+K	16.3	16.7	0.625	0.638	26.13	26.20
U + K	17.8	18.2	0.588	0.590	30.30	30.90
GA_3+U+K	17.8	17.3	0.653	0.638	27.30	27.10
New-LSD at 5 %	1.1	1.1	0.046	0.065	2.89	4.66
at 1%	1.5	1.5	0.060	0.090	3.94	6.59

GA_3 = Gibberellic acid, U= Urea, K= Potassium sulphate

Our results are in coincidence with those obtained by El-Nabawy *et al.* (1978), Ahmed (1988) and El-Garhy (1990) on GA3, Akl *et al.* (1996b) and Omer (2003) on urea and Gobara (1999) on K.

7. Total carbohydrates in the canes:

It is clear from Table (11) that application of K or in combined with urea gave the maximum values of total reserved carbohydrates in the canes in season 2001. The minimum values were detected on vines received GA3 and urea together. The present treatments gave no significance difference on total carbohydrates % in the second season of study. Any treatment including the application of GA3 resulted in a reduction in carbohydrates.

These results are in harmony with those obtained by Weaver (1972) on GA3, Omar (2003) on urea and Abd Elal (1991) on K.

From our results the data presented that to obtained better yield with good quality of Thompson Seedless grapes, it is recommended to use GA3 (at 20 and 40 ppm), 1.0% urea and 2.0% potassium sulphate twice.

Table(11): Effect of foliar application of GA3, urea and potassium sulphate on total sugars in juice berry and total carbohydrates in canes of Thompson seedless grapevines (season 2001 & 2002).

Treatments	Total sugars		Total carbohydrates	
	2001	2002	2001	2002
Control	14.39	14.20	19.09	18.90
GA_3	13.47	13.57	18.17	18.27
U	14.33	14.00	19.33	18.70
K	15.71	15.79	20.81	20.49
GA_3+U	13.45	13.75	18.15	18.45
GA_3+K	14.07	13.99	18.77	18.69
U + K	15.07	15.39	19.70	20.90
GA_3+U+K	13.75	13.79	18.45	18.49
New-LSD at 5 %	0.60	1.20	1.74	NS
at 1%	0.83	1.69		

GA_3 = Gibberellic acid, U= Urea, K= Potassium sulphate

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خصوبة البراعم، النمو، المحصول وجودة الثمار وتأثرهم ببعض المعاملات الزراعية للعنب الطومسون سيد لس

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أجرت الدراسة خلال موسمي ٢٠٠١ ، ٢٠٠٢ لمعرفة درجة استجابة خصوبة البراعم والنمو والإثمار في العنب البناتي بتقنية الرش الورقي بالجبريلين، اليوريا وكبريتات البوتاسيوم

أشارت نتائج الدراسة إلى أن اقل نسبة مئوية لخصوبة البراعم كانت في الكرمات التي تم رشها بالجبريلين أو اليوريا أو الاثنان معا بينما اكبر قيمة فقد كانت في الكرمات التي تم رشها بسماد كبريتات البوتاسيوم وكانت اكبر قيمة لصفات النمو في كرمات العنب التي تم رشها بالجبريلين وكبريتات البوتاسيوم واليوريا أما نضج الخشب فقد كان غالبا في الكرمات التي تم رشها بكبريتات البوتاسيوم بمفردها ولم يكن لمعاملات التجربة أي تأثير على كمية المحصول من خلال عدد عناقيد للكرمة بينما كان لها تأثير ايجابي كبير على كمية المحصول معبرا عنها في وزن العنقود ، وذلك بالمقارنة بعدم الرش.

أما صفات وزن وأبعاد العنقود والحبة ايجابيا بالرش الورقي للمواد الثلاثة معا وأدى رش الجبرلين وكبريتات البوتاسيوم الى تأثيرات مرغوبة وغير مرغوبة على الخصائص الكيميائية للثمار على التوالي وكانت اكبر قيمة للنسبة المئوية للمواد الكربوهيدراتية في القصبات بالكرمات التي تم رشها بكبريتات البوتاسيوم واليوريا معا.

لذا فأنه يمكن التوصية للحصول على أفضل النتائج بحيث يرش كرمات العنب مرتان بالجبريلين (٢٠و ٤٠ جزئ في المليون) واليوريا (١%) وكبريتات البوتاسيوم (٢%). للحصول على محصول ذو صفات عناقيد جيدة.