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Effect of Plant Compost Enriched with Spirulina Platensis Algae as a Partial Replacement of Mineral N Fertilizers on Early Sweet Grapevine

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ABSTRACT

During 2014 and 2015 seasons, Early Sweet grapevines were fertilized with the recommended rate of N via 100% mineral N, 100% plant compost (p c) enriched or not with *Spirulina platensis* algae(S p a) as well as via 25 to 75% inorganic N plus 25 to 75% plant compost with or without *Spirulina platensis* algae. The merit was replacing inorganic N partially by using plant compost enriched or not with *Spirulina platensis* algae. Growth characteristics, leaf pigments, N, P, and K, yield, quality of the berries and juice content of nitrite were investigated. Using N as 50% inorganic N + 50% plant compost enriched with *Spirulina platensis* at 10 ml/ vine improved growth characteristics, yield, cluster weight and quality of the berries. There was a gradual effect on leaf pigments, N, P, K and fruit quality with reducing the percentages of inorganic N from 100 to 0.0% and increasing percentages of plant compost with or without the algae form 0.0 to 100%. Juice content of nitrite and shot berries % gradually declined with reducing inorganic N and increasing plant compost enriched or not with *Spirulina platensis* algae. Using plant compost enriched with *Spirulina platensis* was more favorable than using plant compost alone in this respect. A pronounced promotion on yield and fruit quality of Early Sweet cultivar was observed when the vines were subjected to the recommended rate of N as 50% inorganic N plus 50% plant compost enriched with *Spirulina platensis* algae at 10 ml/ vine.

** Spirulina platensis algae (S p a) - plant compost (p c)

Keywords: Inorganic N, plant compost, *Spirulina platensis* algae, Early Sweet grapevines, yield, berries quality.

INTRODUCTION

Poor yield of Early Sweet grapevines grown under Minia region conditions is considered a big problem facing grape growers. Many attempts were carried out for solving this problem by using organic fertilizers enriched with microorganisms such as *Spirulina platensis* algae (S p a). Adjusting N fertilization by using organic and biofertilization is useful for solving the previous problem for controlling growth and fruiting balance. *(S p a)* has higher content in polyunsaturated fatty acids, pigments, amino acids such as leucine, isoleucine and valine, vitamins B12 and β-carotene, lipids, selenium, sugars, RNA, DNA, sulfated polysaccharides. Sulfoglycolipids, lipids and protein and pigments theallophcocianin (Beley, 2002 and 2008 and Henrikson, 2010). Application of the recommended rate of N through organic manures enriched with different microorganisms as a partial replacement of inorganic N was found by many workers to improve, growth and fruiting of grape cultivars (El-Rawy 2007; Mostafa 2008; EL-Kady2011;EL-Salhy *et al* 2011; Allam- Aida *et al.,* 2012; Masoud 2012; Mahmoud, 2012; Abdelaal *et al.,* 2013; AL-Khafagy 2013 ;EL-Salhy *et al* 2013; Abd El- Kareem, 2014; Allam, 2014; Shaaban, 2014; Ali- Samar, 2015 ; El-Wany, 2015 and EL-Salhy *et al* 2017)

This study aimed to study the effect of using(p c) enriched with *(S p a)* as a partial replacement of inorganic N fertilizer in Early Sweet grapevines grown under Minia conditions.

**** Spirulina platensis algae (S p a) - plant compost (p c)**

MATERIALS AND METHODS

This study was carried out during 2014 and 2015 seasons on fifty four uniform in vigour 10-year old Early sweet grapevines buded onto salt Greek grapevine rootstock grown in a private vineyard located at West Matay, Matay district, Minia Governorate where the soil is sandy well drained. The selected vines (54) were planted at 2x 3 m apart and pruned during the first week of Jan. during the two seasons using spur pruning system. The vines were trellised by Gable supporting system. Vine load was 57 eyes per vines on the basis of 15 fruiting spurs x three eyes plus six replacement spurs x two eyes. Drip irrigation system was followed using well water containing 250 ppm salinity. Soil analysis was done according to Peach and Tracey (1968).

Table 1. Soil's analysis :

Characters	Values	Characters	Values
Particle size distribution			
Clay %	32.2	P	3.3
Silt %	18.1	K	80.0
Sand %	49.0	Ca	71.0
Texture	Sandy	Mg	5.0
pH (1: 2.5 extract)	8.80	EDTA extractable available micronutrients (ppm)	
E.C. mmhos/1 cm 25oC	0.73	Zn	2.2
Organic matter %	1.2	Fe	1.7
Total CaCO3 %	20	MN	0.8
Available macronutrients (ppm)		Cu	0.8
N	22.0		

All the (54) vines received all the horticultural practices that were already done in the vineyard except inorganic, organic and biofertilization treatments.

The following nine treatments application were included in this study

1- The recommended N (60 N / vine) via 100% inorganic N (179.0 g ammonium nitrate / vine / year) alone.
2- The recommended N via 75 % inorganic N (134.25 ammonium nitrate / vine/ year) + 25%(p c) (2% N) (0.75 kg / vine / year).
3- The recommended N via 75 % inorganic N + 25% (p c) + 5 ml (*S p* a) per vine.
4- The recommended N via 50% inorganic N (89.59 ammonium nitrate / vine / year) + 50% (p c) (1.5 kg / vine / year).
5- The recommended N via 50% inorganic N + 50% (p c) + 10 ml *(S p a)* per vine.

6- The recommended N via 25% inorganic N (49.89 ammonium nitrate / vine/ year) + 75% (p c) (2.25 kg / vine / year).
7- The recommended N via 25% inorganic N + 75% plant compost + 15 ml (S p a) per vine.
8- The recommended N via 0.0% inorganic N + 100% (p c)3.0 kg / vine / year).
9- The recommended N via 0.0% inorganic N + 100% (p c) + 20 ml *(S p a)* per vine.

Treatments were replicated three times, two vines per each. Ammonium nitrate (33.5%N) as a source of inorganic N was divided into three unequal batches applied as 45% at growth start (1st week of Mar.), 35% just after berry setting (mid. week of April and 20% one month after harvesting (last week of July). *(S p a)* amount (5 to 20 ml) was mixed with plant compost (p c) before use. (p c) was added once at the last week of January. Randomized complete block design (RCBD) was followed.

Tables (2 & 3)show the analysis of(p c)and(S p a).

Table 2. Analysis of the mature compost

Parameter	Value	Parameter	Value	Parameter	Value
Moisture %	29.0	C/N ratio	18.82	Total Mg %	1.21
Organic matter %	30.7	Total N %	2.0	Total Fe (ppm)	320.0
Organic carbon %	31.25	Total P %	0.52	Total Mn (ppm)	45.0
pH	8.5	Total K %	1.12	Total Zn (ppm)	34.0
E/C. (ds. M-1)	6.5	Total Ca %	1.25	Total Cu (ppm)	42.0

Table 3. *Spirulina platensis* analysis (Koru *et al.*, 2008).

Parameters	Values
	(g/100g)
Moisture	3.5
Protein	63.5
Fat (Lipids)	9.5
Fibre	3.00
Ash	6.70
N- free extract	15
Colorants	
Phycocyanin	15.6 g.
Carotenoids	456.00 mg.
Chlorophyll- a	1.30 g.
Vitamins	(mg)
Provitamin A	213.00
Thiamin (V.B_1)	1.92
Riboflavin (V. B_2)	3.44
Vitamin B_6	0.49
Vitamin B_{12}	0.12
Vitamin E	10.40
Niacin	11.30
Folic acid	40
Pantothenic acid	0.94
Inositol	76.00
Minerals	
Phosphorus	916.00 mg.
Iron	53.60 mg.
Calcium	168 mg.
Potassium	1.83 g.
Sodium	1.09 g.
Magnesium	250 mg.

During the two seasons of study, were determine the following measurements:

1- Vegetative growth characteristics, the length of main shoot (cm.), leaves number / shoot and leaf area (cm2) (Ahmed and Morsy, 1999). The five basal internodes of ten canes per vine was used to calculate the average of can thickness (cm) in just before winter pruning (first week of January by using a vernier caliper. Weight of pruning (in kg.) per vine was estimated by weighing the removal oneyear old wood after pruning (first week of January).
2-Leaf pigments namely a & b total chlorophylls, and total carotenoids (mg/ 100 g F.W.) were estimated according to (Von- Wettstein, 1957 and Hiscoy and Isralston,1979).
3- N, P, K % in the petioles of the leaves according to (Peach and Tracey, 1968; Summer, 1985 and Wilde *et al*., 1985) on dry weight basis.
4- Yield (last week of June), clusters number / vine and cluster weight (g.)
5- Short berries %, berry weight (g.), T.S.S. %, reducing sugars %, acidity % as tartaric acid (g / 100 ml) according to (Lane and Eynon, 1965 and A.O.A.C., 2000) and nitrite on the juice (ppm) (Sen and Donaldson, 1998 and Ridnour- Lisa *et al*., 2000).

New L.S.D. at 5% test was used to make all comparison among treatment means (Snedecor and Cochran, 1967 and Mead *et al*., 1993).

RESULTS AND DISCUSSION

1- Growth aspects:

Table (4) cleared that fertilizing the vines with the recommended N via 50 to 75% inorganic N plus 25 to 50% (p c) enriched or not with *(S p a)* at 5 to 10 ml/ vine significantly increased the length of main shoot, leaves number/ shoot, leaf area, cane thickness and pruning weight compared with using N as 100% inorganic N or when inorganic N was used at lower than 50%. A significant reduction was observed on these growth aspects with using N as 0.0 to 25% inorganic N plus 75 to 100% (p c) with or without using *(S p a)*. Using *(S p a)* with (p c)was significantly followed by enhancing all growth characteristics compared with using (p c) alone. The vines that received N as 50% inorganic N + 50% (p c) enriched with *(S p a)* at 10 ml / vine had the highest values. On the other hand the vines received N completely via (p c) without (*S p a) had the minimum values*. during both seasons of study.

Table 4. Effect of using plant compost (p c) enriched with *Spirulina platensis* algae (S p a) on some growth aspects of Early sweet grapevines during 2014 and 2015 seasons.

Treatments	Main shoot length (cm.)		No. of leaves / shoot		Leaf area (cm)^2		Pruning wood / vine (kg.)		Cane thickness (cm)	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
100 % inorganic N	95.2	96.8	20.0	22.0	141.0	142.3	1.71	1.80	1.21	1.17
75 % inorganic + 25% compost	96.7	98.5	22.0	24.0	144.0	145.4	1.81	1.90	1.41	1.37
75 % inorganic + 25% compost +S	99.0	100.8	25.0	27.0	146.7	148.0	1.92	2.01	1.50	1.46
50 % inorganic + 50% compost	102.0	103.9	27.0	29.0	149.0	150.3	2.00	2.09	1.60	1.56
50 % inorganic + 50% compost + S	105.0	106.9	30.0	33.0	151.9	153.2	2.11	2.20	1.65	1.61
25 % inorganic + 25% compost	92.0	93.9	16.0	18.0	136.0	137.4	1.52	1.60	1.10	1.04
25 % inorganic + 25% compost +S	98.5	95.3	18.0	20.0	138.0	139.4	1.62	1.71	1.16	1.12
0.0 % inorganic + 100 % compost	87.7	89.6	12.0	14.0	131.0	132.7	1.31	1.40	0.99	0.94
0.0 % inorganic + 100 % compost+ S	89.2	91.0	14.0	16.0	133.3	135.0	1.41	2.00	1.05	1.01
New L.S.D. at 5%	1.4	1.2	2.0	2.0	1.2	1.2	0.07	0.07	0.05	0.05

S = *Spirulina platensis* algae

2-Leaf pigments and different nutrients:

Tables (5 & 6) showed that Early Sweet grapevines which treated with the recommended N via 0.0 to 75% inorganic N plus 25 to 100% (p c) with or without using *(S p a)* at 5 to 20ml / vine significantly increased leaf pigments as well as N, P and K nutrients in the leaves over the use of N as 100% inorganic N. The increase in these chemical constituents was significantly correlated with reducing inorganic N from 100 to 0.0 % and increasing percentages of (p c) enriched or not with *(S p a)* at 5 to 20 ml / vine. Using *(S p a)* along with (p c) was superior to using (p c) alone in enhancing these chemical constituents. The vines recived N, as 100% inorganic N gave the lowest values. The vines with N through 100% (p c) enriched with *(S p a)* at 20 ml/ vine (without using inorganic N) gave the maximum values during the two seasons.

Table 5. Effect of using (p c) enriched with *(S p a)* on leaf pigments and percentage of N in the leaves of Early sweet grapevines during 2014 and 2015 seasons.

Treatments	Chlorophyll a (mg/ 100 g F.W.)		Chlorophyll b (mg/ 100 g F.W.)		Total chlorophylls (mg/ 100 g F.W.)		Total carotenoids (mg/ 100 g F.W.)		Leaf N %	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
100 % inorganic N	4.3	4.5	2.3	2.1	6.6	6.6	2.1	1.9	1.51	1.49
75 % inorganic + 25% compost	4.7	4.9	2.7	2.5	7.4	7.4	2.5	2.3	1.61	1.56
75 % inorganic + 25% compost +S	5.1	5.3	3.1	2.9	8.2	8.2	2.9	2.7	1.68	1.63
50 % inorganic + 50% compost	5.5	5.7	3.4	3.2	8.9	8.9	3.2	3.0	1.75	1.70
50 % inorganic + 50% compost + S	6.0	6.2	3.7	3.5	9.7	9.7	3.5	3.3	1.83	1.78
25 % inorganic + 25% compost	6.3	6.7	4.0	3.8	10.3	10.5	3.8	3.6	1.90	1.86
25 % inorganic + 25% compost +S	7.0	7.1	4.3	4.1	11.3	11.2	4.1	4.0	1.97	1.93
0.0 % inorganic + 100 % compost	7.4	7.6	4.6	4.4	12.0	12.0	4.4	4.3	2.05	1.99
0.0 % inorganic + 100 % compost+ S	7.9	8.0	5.0	4.8	12.9	12.8	4.7	4.6	2.15	2.06
New L.S.D. at 5%	0.3	0.3	0.3	0.3	0.4	0.4	0.3	0.3	0.05	0.05

S = *Spirulina platensis* algae

Table 6. Effect of using(p c) enriched with *(S p a)*on the percentages of P and K in the leaves , yield and cluster weight of Early sweet grapevines during 2014 and 2015 seasons.

Treatments	Leaf P %		Leaf K %		No . of clusters / vine		Cluster weight (g.)		Yield / vine (kg.)	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
100 % inorganic N	0.17	0.14	1.21	1.23	22.0	27.0	501.0	498.0	11.0	13.4
75 % inorganic + 25% compost	0.21	0.17	0.27	0.30	22.0	29.0	514.0	511.0	11.3	14.8
75 % inorganic + 25% compost +S	0.24	0.21	0.35	0.37	22.0	31.0	526.0	523.0	11.6	16.2
50 % inorganic + 50% compost	0.28	0.24	0.42	0.45	22.0	33.0	540.0	537.0	11.9	17.7
50 % inorganic + 50% compost + S	0.31	0.27	0.50	0.53	22.0	35.0	553.0	550.0	12.2	19.3
25 % inorganic + 25% compost	0.34	0.31	0.55	0.60	22.0	24.0	476.0	473.0	10.5	11.4
25 % inorganic + 25% compost +S	0.37	0.34	0.61	0.69	22.0	25.0	488.0	485.0	10.7	12.1
0.0 % inorganic + 100 % compost	0.40	0.37	0.67	0.76	22.0	23.0	450.0	447.0	9.9	10.3
0.0 % inorganic + 100 % compost+ S	0.43	0.41	0.74	0.85	22.0	24.0	463.0	460.0	10.2	11.6
New L.S.D. at 5%	0.03	0.04	0.05	0.06	NS	2.0	12.0	12.0	0.03	0.4

S = *Spirulina platensis* algae

3- Yield and cluster weight:

Table (6) cleared that the application of the recommended rate N via 50 to 75 % inorganic N plus 25 to 50% (p c) enriched or not with (S p a) significantly improved yield (kg.), clusters number per vine and cluster weight compared with using inorganic N, when inorganic N was applied at 25% or when plant compost was added as 100%. Using N as 100% inorganic N significantly increased compared to use N as 25% inorganic N as well as when N was added via (p c) at 100%. Using inorganic N at lower than 50% significantly reduced the yield and cluster weight even with the application of (p c) enriched with *(S p a)* at 10 ml /vine. Using (p c) enriched with these algae was significantly superior to using (p c) alone in improving the yield and cluster weight. Fertilizing with N as 50% inorganic + 50% (p c) enriched with *(S p a)* gave the highest yield. The yield /vine was 12.2 and 19.3 kg compared with the yield of the vines that were fertilized with N inorganic form that reached 11.0 and 13.4 kg, during the study seasons, respectively.The increament percentage in the yield reached 10.9 and 44.0 % during 2014 and 2015 seasons, respectively.

4- Percentages of shot berries:

As shown in Table (7), fertilizing Early sweet grapevines with N as 0.0 to 75% inorganic N plus 25 to 100% (p c) enriched or not with *(S p a)* significantly reduced the percentage of shot berries in the clusters compared with using N as 100% inorganic N. The reduction percentage of shot berries was significantly related to the reduction in the percentage of inorganic N and the increase in the percentages of (p c) enriched or not with *(S p a)*. Using (p c) enriched with *(S p a)* caused a significant reduction in the percentages of shot berries compared with using (p c) alone. N completely as inorganic N caused the highest values of shot berries (12.0 & 11.7%). While the vines fertilized with N completely via (p c) enriched with (S p a) had the minimum values (4.3 % 3.6%) during the tow seasons.

5-Quality of the berries:

Ihe data in Table (7) showed that fertilization of the vines with N as 0.0 to 75% inorganic N plus 25 to 100% (p c) with or without the application of *(S p a)* was significantly improve the quality of the berries in favor of increasing berry weight, T.S.S. %, and reducing sugars and decreasing total acidity % and nitrite in the juice compared to the use of N through 100% inorganic N. The promotion on quality was significantly associated with reducing the percentages of inorganic N from 100 to 0.0% and at the same time increasing the percentages of (p c) with or without *(S p a)*. The significant effect on quality of the berries due to using (p c) enriched with *(S p a)* when compared with using plant compost alone. Supplying the vines with N as 100% (p c) enriched with *(S p a)* gave the best results during both seasons.

Table 7. Effect of using(p c) enriched with *(S p a)*on the percentage of shot berries and some physical and chemical characteristics of the berries of Early sweet grapevines during 2014 and 2015 seasons.

Treatments	Shot berries %		Berry weight (g.)		T.S.S. %		Reducing sugars %		Total acidity %		Nitrite juice (ppm)	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
100 % inorganic N	12.0	11.7	5.00	5.02	18.0	17.9	13.9	13.8	0.719	0.718	1.92	1.99
75 % inorganic + 25% compost	11.0	10.6	5.12	5.23	18.4	18.2	14.4	14.1	0.697	0.692	1.71	1.68
75 % inorganic + 25% compost +S	10.0	9.6	5.26	5.36	18.7	18.5	14.7	14.4	0.676	0.671	1.29	1.55
50 % inorganic + 50% compost	8.8	8.6	5.55	5.50	19.0	18.9	15.0	14.8	0.650	0.650	1.51	1.45
50 % inorganic + 50% compost + S	8.0	7.5	5.71	5.69	19.3	19.4	15.4	15.1	0.620	0.622	1.45	1.35
25 % inorganic + 25% compost	7.0	6.6	5.92	5.93	19.6	19.8	15.8	15.5	0.592	0.600	1.30	1.25
25 % inorganic + 25% compost +S	6.0	5.6	6.09	6.10	20.0	20.2	16.2	15.8	0.570	0.579	1.20	1.15
0.0 % inorganic + 0.0% compost	5.0	4.6	6.22	6.23	20.4	20.5	16.5	16.1	0.550	0.550	1.10	1.04
0.0 % inorganic + 0.0% compost+ S	4.3	3.6	6.33	6.34	20.8	20.9	16.8	16.4	0.520	0.522	1.01	0.94
New L.S.D. at 5%	0.9	1.0	0.11	0.12	0.3	0.3	0.3	0.3	0.020	0.22	0.11	0.12

S = *Spirulina platensis* algae

DISCUSSION

Previous studies showed that organic and biofertilization especially with plant wastes enriched with microorganisms were favorable in reducing the expenses of mineral N, salinity problems, antibiotics biosynthesis, (Kannaiyan, 2002, Irizar – Garza *et al.,* 2003 and Mostafa 2008) (Miller *et al.,* 1990).

The biochemical composition of *Spirulina* (showing that it rich, in the polyunsaturated fatty acid γ, high protein concentration, essential amino acids, high concentration of provitamin A, vitamin B12 and β–carotene, essential fatty acids as linolenic acid, and polynsaturated fatty acids (Koru *et al*., 2008 Koru, 2009 and Wu, *et al.,* 2005). Cyanonacteria and algae had a wide range colored compounds, (Shekharam *et al.,* 1987). A*(S p a)* contains about 13.5% carbohydrates. The Spirulina antiviral activity due to sulfated polysccharides, sulfoglycolipids, and a protein- bound pigment, theallophcocianin (Barron *et al.,* 2008). *Spirulina* contains 2.2 % - 3.5% of RNA and 0.6 %-1% of DNA, which represents less than 5% of these acids, based on dry weight. (Ciferri, 1983; Backer and Venkataraman, 1984, Belay 2002 and 2008; Diraman *et al.,* 2009; Koru, 2009 and Henrikson, 2010).

The obtained results are in the same line with those reported by El-Rawy, (2007); Mostafa (2008); Masoud (2012); Abdelaal *et al.,* (2013); El- Khafagy (2013); El-Salhy (2013); Abd El- Kareem (2014); Alam (2014); Shaaban (2014); Ali- Samar (2015); El- Wany (2015); and El-Salhy *et al*. (2017).

CONCLUSION

For solving the problem poor yield of Early sweet grapevines grown under Minia region conditions, it is advised to fertilize the vines with N (60 g / vine/ year) as 50% inorganic N + 50%(p c) enriched with 10 ml(*S p* a).

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استخدام الكمبوست النباتى المزود بطحلب الاسبيرولينا بلاتنسيس كبديل جزئى للاسمدة النتروجينية المعدنية فى كروم العنب الايرلى سويت

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تم خلال موسمى 2014 ، 2015 تسميد كرمات العنب الايرلى سويت بالنتروجين الموصى به خلال 100% تسميد معدنى ، خلال 100% كمبوست النبات المزود أو الغير مزود بطحلب الاسبيرولينا بلاتنسيس ، 25- 75 % نتروجين غير عضوى بالاضافة الى 25- 75% كمبوست النبات المزود أو الغير مزود بطحلب الاسبيرولينا بلاتنسيس وكان الهدف استبدال النتروجين الغير عضوى جزئيا باستخدام كمبوست النبات المزود او الغير مزود بطحلب الاسبيرولينا بلاتنسيس ولقد تم دراسة درجة استجابة صفات النمو الخضرى وصبغات الورقة والنتروجين والفوسفور والبوتاسيوم وكمية المحصول وخصائص الجودة للحبات ومحتوى العصير من النتريت لهذه المعاملات. كان استخدام النتروجين على هيئة 50% سماد نتروجينى غير عضوى+50% الكمبوست النباتى المزود بطحلب الاسبيرولينا بلاتنسيس بمعدل أقل للكرمة فعالا فى تحسين صفات النمو الخضرى وكمية المحصول ووزن العنقود وخصائص الجودة للحبات وكان هناك تحسن تدريجى فى صبغات الورقة والنتروجين والفوسفور والبوتاسيوم وخصائص الجودة بتقليل النسبة المئوية المستخدمة من النتروجين المعدنى من 100 الى صفر % وزيادة النسبة المئوية المستخدمة من كمبوست النبات مع أو بدون استخدام طحلب الاسبيرولينا بلاتنسيس من صفر الى100% وكان هناك نقص تدريجى فى محتوى العصير من النتريت والحبات الصغيرة فى العنقود بتقليل النسبة المئوية المستخدمة من التسميد النتروجينى المعدنى من100 الى صفر% وزيادة النسبة المئوية المستخدمة من الكمبوست النباتى المزود او الغير مزودج بطحلب الاسبيرولينا بلاتنسيس وكان استخدام كمبوست النبات المزود بطحلب الاسبيرولينا بلاتنسيس مفضلا عن استخدام الكمبوست النباتى فقط فى هذا الصدد. كان هناك تحسن واضح فى كمية محصول الكرمة وخصائص الجودة للحبات فى كرمات العنب الايرلى سويت عند تسميد الكرمات بالكمية الموصى بها من النتروجين من خلال50% سماد نتروجينى غير عضوى جنبا الى جنب مع استخدام50% الكمبوست النباتى المزود بطحلب الاسبيرولينا بلاتنسيس بمعدل أقل للكرمة.

الكلمات الدالة : النتروجين الغير عضوى ، الكمبوست النباتى، طحلب الاسبيرولينا بلاتنسيس – كرمات العنب الايرلى سويت.