Reducing Inorganic N Partially In Superior Vineyards By Using Organic Manures Enriched With Spirulina Plantensis Algae

Mohamed M.A.: Ali A.H.; Gobara A.A. and Abd El- Razik, M.A.

Hort. Dept. Fac. of Agric. Minia Univ. Egypt
Faissalfadel@yahoo.com

Abstract: During 2013 & 2014 seasons, Superior grapevines were fertilized with inorganic N besides four organic manures namely farmyard, compost as well as , fulvic and humic acids enriched with Spirulina plantensis algae as a trial for reducing mineral N fertilizer partially. Yield and quality of the berries in response to the present treatments were investigated. Using N as 50 to 75% inorganic N besides any organic manures (farmyard, compost, as well as fulvic or humic acids) enriched with Spirulina plantensis algae was very effective in improving the yield and cluster characters and reducing shot berries rather than using N via inorganic N fertilization alone. Supplying the vines with N as 25 to 75% inorganic N plus organic manures enriched with algae was preferable in improving quality of the berries in terms of increasing berry weight and dimensions, T.S.S., T.S.S. /acid and reducing sugars and decreasing total acidity % and both nitrate and nitrite in the juice rather than application of N via inorganic N fertilization alone. The amounts of CO_2 and total counts of bacteria in the soil were gradually enhanced with reducing the percentages of inorganic N and increasing the levels of organic manures enriched with algae. The best results with regard to yield and quality of Superior grapevines were obtained due to supplying the vines with N as 50% inorganic plus humic acid at 20 ml/ vines enriched with Spirulina plantensis algae at 5 ml / vine.
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1. Introduction

Nowadays, many attempts were established for reducing pollution in our environment by reducing mineral fertilizers through application of organic farming. Using organic manures as farmyard, compost, and humic substances enriched with various microoraganisms is considered an important tool for achieving of this goal. (**Dalbo, 1992; Davis and Ghabbour, 1998 and Kannaiyan, 2002**).

Previous studies emphasized the beneficial effects of replacing mineral N fertilization with organic manures enriched with different biofertilizers for improving yield and quality of the berries in various grapevine cvs (**Refaai , 2011; Uwakiem , 2011; Rabie and Negm, 2012; Allam- Aida *et al.*, 2012; Ahmed *et al.*, 2012a and 2012 b; El- Khafagy, 2013; Abdelaal *et al.*, 2013; Alam, 2014 and Abd El- Kareem, 2014**).

This study was carried out for examining the effect of replacing inorganic N partially in Superior vineyards by using different organic manure enriched with Spirulina plantensis algae.

2. Material and Methods

This study was carried out during 2013 and 2014 seasons on forty- eight uniform in vigour 11 years- old Superior grapevines. The selected vines are grown in a private vineyard located at El- Hawarta village, Minia district, Minia Governorate where the texture of the soil is clay (Table 1) . Soil analysis was done according to the procedures that outlined by **Chapman and Pratt (1987).**

Table (1): Analysis of testes soil

Constituent	Values
Sand %	5.1
Silt %	14.0
Clay %	80.9
Texture	Clay
O.M. %	2.55
pH (1: 2.5 extract)	7.69
EC (1 :2.5 extract) (mmhos/cm/25^{o}C)	0.91
$CaCO_3$%	1.55
Total N %	0.09
Available P (Olsen method , ppm)	5.9
Available K (ammonium acetate , ppm)	4.90

The selected vines are planted at 1.5 x 3 meters apart. The chosen vines were trained by cane pruning system leaving 72 eyes/ vine (six fruiting canes x 10 eyes plus six renewal spurs / two eyes) using Gable supporting method. Winter pruning was carried out at the first week of Jan. during both seasons. Surface irrigation system was followed using Nile water.

This study consisted from the following sixteen treatments:

1- Application of the suitable N (80 g N / vine / year) completely via inorganic N (239 g ammonium nitrate vine 33.5 % N)
2- Application of the suitable N via 75% inorganic N (217 g ammonium nitrate / vine)
3- Application of the suitable N via 75% inorganic N + 25% farmyard manure enriched with *Spirulina plantensis* algae (8.0 kg + 5 ml algae) .
4- Application of the suitable N via 75% inorganic + 25% compost enriched with *Spirulina plantensis* algae (1.0 kg + 5 ml algae).
5- Application of the suitable N via 75% inorganic N + fulvic acid at 10 ml / vine + 5 ml algae.
6- Application of the suitable N via 75% inorganic N + humic acid at 10% 75% inorganic + humic acid at 10 ml/ vine + 5 ml algae.
7- Application of the suitable N via 50% inorganic N (119/g g ammonium nitrate / vine) alone.
8- Application of the suitable N via 50% inorganic + 50 % farmyard manure enriched with Algae (16.0 kg + 5 ml algae).
9- Application of the suitable N via 50 % inorganic N + 50 % compost enriched with algae (2.0 kg + 5 ml algae).
10- Application of the suitable N via 50 % inorganic N + Fulvic acid at 20 ml + 5 ml algae / vine.
11- Application of the suitable N via 50% inorganic N + humic acid at 10 ml + 5 ml algae / vine.
12- Application of the suitable N via 25% inorganic N alone (60 g ammonium nitrate / vine).
13- Application of the suitable N via 25% inorganic N + 75% farmyard manure (24.0 kg + 5 ml Algae).
14- Application of the suitable N via 25% inorganic N + 75% compost (3.0 kg compost + 5 ml Algae).
15- Application of the suitable N via 25% inorganic N + fulvic acid at 30 ml + 5 ml aglae.
16- Application of the suitable N via 25% inorganic N + humic acid at 30 ml + 5 ml Algae.

Each treatment was replicated three times, one vine per each. Ammonium nitrate was divided into four unequal batches and added as 30% at growth start (middle of Feb.), 30% just after berry setting (middle of April), 20% 21 days after berry setting and 20%, 21 days after harvesting.

Both farmyard manure and compost were applied once at the middle of January. Both fulvic acid and humic acid were applied once at growth start (middle of February).

Randomized complete block design was adopted was used for carrying out statistical analysis.

During both seasons, the following characters were measured, yield per vine (kg.), weight (g.), length and width of cluster (cm), percentage of shot berries; weight (g.), longitudinal and equatorial (cm.) of berry; T.S.S. % , total acidity % (as tartaric acid / 100 ml juice) (**A.O.A.C., 2000**), T.S.S./ acid reducing sugars % (**A.O.A.C., 2000**) nitrate and nitrite in the juice (ppm) (**Ridnour- Lisa *et al.*, 2000**) and total counts of bacterial (cfu, (cell forming units) /1.0 g soil) (**Cochran, 1950**) and the amounts of CO_2 (as mg/ 100 g soil) (**Abd El- Malek and Ishac, 1968**).

Statistical analysis was done using New L.S.D. at 5% parameter (**Mead *et al.*, 1993**).

3. Results

1- Yield per vine and cluster characters:

Data in Table (2) clearly show that using the suitable N (80 g / vine / year) through 50 to 75 inorganic N plus 25 to 50% farmyard or compost and 10 to 20 ml fulvic or humic acids enriched with algae biofertilizer significantly was accompanied with improving the yield and cluster characters namely weight, length and width) rather than using N via inorganic form at 25 to 75% without organic manures. A significant reduction on the yield and cluster characters was observed with using inorganic N as 25% out of the suitable N even with the application of organic manures enriched with algae. A slight and unsignificant promotion on the yield and cluster characters was observed with using N as 75% with any organic manures comparing with using N as 50 % inorganic with organic manures enriched with algae. Therefore, from economical and pollution point of view using N as 50 % inorganic plus organic manure enriched with algae gave the best results with regard to yield and cluster characters. The best organic manures enriched with algae was humic acid followed by fulvic acid, compost and farmyard manure, in descending order. The best results with regard to yield from economical point of view were obtained with using N as 50% inorganic + 20ml humic acid enriched algae. Under such promised treatment yield/ vine reached 7.7 & 13.2 during both seasons, respectively. Vines fertilized with N as 100% inorganic produced 6.7 and 10.7 kg during 2013 & 2014 seasons, respectively. These results were true during both seasons.

2-Percentage of shot berries:

Data in Table (3) obviously reveal that using N as 50 to 75% inorganic N plus 25 to 75% farmyard or compost as well as both humic and fulvic acids enriched with algae significantly reduced the percentage of shot berries comparing with using N via inorganic N fertilization alone. A significant increase on such phenomenon was observed with using N as inorganic N at percentage 25% even with the application of organic manures enriched with algae. The best organic manures enriched with algae in this respect was humic acid followed by fulvic acid. However, farmyard manure occupied the last position in this respect. The minimum values of shot berries % (4.45 & 4.2 %) was recorded on the vines that fertilized with N as 75% inorganic N plus 10ml humic acid enriched with algae. The highest values of shot berries % (8.5 & 8.3 %) were recorded on the vines that received inorganic N at 25% of the suitable N alone. These results were true during both seasons.

3- Quality of the berries:

It is evident from the data in Tables (3 to 5) that supplying the vines with N as 25 to 75% inorganic N besides any one of the four organic manures (25 to 75% compost and farmyard manures and 10 to 30 ml fulvic or humic acids/ vine) significantly was very effective in improving quality of the berries in terms of increasing berry weight and dimensions, T.S.S. %, T.S.S. /acid and reducing sugars and decreasing total acidity %, nitrate and nitrite in the juice comparing with using N as inorganic N fertilization alone. The promotion on fruit quality was associated with reducing inorganic N percentages from 100 to 25% and at the same time increasing percentages of farmyard and compost from 0.0 to 75% as well as levels of fulvic and humic acids from 10 to 30 ml/ vine. The best results with regard to fruit quality were obtained with using N as 25% inorganic besides 30 ml humic acid vine enriched with Spirulina plantensis algae. Unfavourable effects on quality of the berries were observed with using N as 25% inorganic N without using organic and biofertilization. These results were true during both seasons.

4- The amounts of CO_2 and total counts of bacteria in the soil:

It is clear from the obtained data in Table (5) that the amounts of CO_2 and the total counts of bacteria in the soil were significantly improved in response to treating the vines with N as 25 o 75% inorganic plus organic and biofertilization rather than fertilization with inorganic N form alone. The promotion was significantly associated with reducing percentages of inorganic N and at the same times increasing the levels of organic manures enriched with algae. The best organic manures enriched with algae, in descending order were humic acid, fulvic acid, compost and farmyard manures. The maximum values of CO_2 (27.2 & 28.0 g / 100 g soil) and total counts of bacteria (6.4 6 & 6.5 6 cfu/ 1.0 g soil) during both seasons, respectively were recorded on the soil under the vines that received N as 25% inorganic besides 40 ml humic acid enriched with 5 ml Spirulina plantensis algae. The lowest values were recorded on the soil under the vines that received N as 100 % inorganic N. Similar results were announced during both seasons.

4. Discussion

The previous positive action of organic manures and biofertilization with Spirulina plantensis algae on growth, vine nutritional status, yield and berries quality was attributed mainly to the beneficial effects of these fertilizers in reducing soil salinity, soil pH, leaching process and soil erosion and enhancing the production of natural hormones namely IAA, GA_3 and cytokinins, root development, nutrient availability, soil organic matter, microbial activity; soil aggregation and aeration, permeability of soil , water holding capacity , nutrient transport, photosynthesis process, fixation of N, water use efficiency, vitamins B, solubility of most nutrients soil workability, resistant to drought, formation of humus and converting of insoluble sulphur to soluble one (**Dalbo , 1992 and Davis and Ghabbour, 1998**). The results regarding the promoting effect of organic manures and biofertilization on growth, vine nutritional; status, yield and berries quality are in harmony with those obtained by **Refaai (2011); Uwakiem (2011); Rabie and Negm (2012); Allam – Aida *et al.*, (2012), Ahmed *et al.*, (2012a) and (2012b); El- Khafagy (2013) ; Abdelaal *et al.*, (2013) and Abd El- Kareem (2014)** on different grapevine cvs.

For improving yield and berries quality of Superior grapevines and at the same time reducing environmental pollutions, it is advised to use the suitable N (80 g / vine) through 50% inorganic N + 20 ml humic acid enriched with 5 ml Spirulina plantensis algae.

Table (2): Effect of using a part of mineral N fertilizer with some organic manure enriched with Spirulina plantensis algae on yield / vine as well as weight , length and width of cluster of Superior grapevines during 2013 & 2014 seasons.

Inorganic and organic manures enriched with Algae treatments	Yield / vine (kg.)		Cluster weight (g.)		Cluster length (cm.)		Cluster width (cm.)	
	2013	2014	2013	2014	2013	2014	2013	2014
100 % inorganic (inorg.)	6.7	10.7	371.0	381.0	26.0	26.3	15.0	14.3
75% inorg. alone	6.5	10.4	360.0	370.0	25.3	25.6	14.5	13.8
75% inorg. + F.Y.M. + Algae	7.5	12.2	397.0	407.0	26.8	27.1	15.6	14.9
75% inog. + Compost + Algae	7.6	12.2	398.0	408.0	27.5	27.8	16.1	15.4
75% inorg. Fulvic + Algae	7.6	13.1	399.5	410.0	28.1	28.4	16.6	16.0
75% inorg.+ humic + Alage	7.7	13.3	405.0	416.0	28.7	29.0	17.0	16.3
50 % inorg. alone	6.7	9.7	350.0	360.0	24.7	25.0	14.0	13.7
50 %inorg. + F.Y.M. + Algae	7.5	12.2	396.0	406.0	26.4	27.0	15.5	14.8
50 % inog. + Compost + Algae	7.5	12.2	397.0	407.0	27.4	27.7	16.0	15.3
50 % inorg. Fulvic + Algae	7.6	12.7	398.0	409.0	28.0	28.3	16.5	15.8
50 % inorg.+ humic + Algae	7.7	13.2	403.0	414.0	28.6	28.9	16.9	16.2
25% inorg. alone	5.7	6.8	315.0	325.0	21.0	21.3	11.5	10.8
25% inorg. + F.Y.M. + Algae	5.8	7.6	320.0	330.0	22.0	22.3	12.0	11.3
25% inog. + Compost + Algae	5.9	8.0	325.0	335.0	22.7	23.0	12.5	11.8
25% inorg. Fulvic + Algae	5.9	8.2	330.0	340.0	23.4	23.7	13.0	12.3
25% inorg.+ humic + Alage	6.0	8.7	336.0	347.0	24.1	24.4	13.5	12.8
New L.S.D. at 5%	**0.3**	**0.3**	**10.0**	**10.9**	**0.6**	**0.7**	**0.5**	**0.5**

F.Y.M. = Farmyard manure

Table (3): Effect of using a part of mineral N fertilizer with some organic manure enriched with Spirulina plantensis algae on the percentage of shot berries and berry weight and dimensions (longitudinal and equatorial) of Superior grapevines during 2013 & 2014 seasons.

Inorganic and organic manures enriched with Algae treatments	Shot berries %		Berry weight (g.)		Berry longitudinal (cm.)		Berry equatorial (cm.)	
	2013	2014	2013	2014	2013	2014	2013	2014
100 % inorganic (inorg.)	6.1	5.9	3.30	3.37	2.28	2.25	2.08	2.05
75% inorg. alone	6.5	6.3	3.22	3.29	2.21	2.18	2.01	1.98
75% inorg. + F.Y.M. + Algae	5.7	5.5	3.35	3.42	2.35	2.32	2.15	2.12
75% inog. + Compost + Algae	5.3	5.1	3.40	3.47	2.42	2.39	2.22	2.19
75% inorg. Fulvic + Algae	4.9	4.7	3.45	3.52	2.49	2.46	2.29	2.26
75% inorg.+ humic + Alage	4.4	4.2	3.50	3.58	2.55	2.52	2.35	2.32
50 % inorg. alone	6.8	6.6	3.12	3.20	2.13	2.10	1.93	1.90
50 %inorg. + F.Y.M. + Algae	5.8	5.6	3.55	3.62	2.62	2.59	2.42	2.39
50 % inog. + Compost + Algae	5.4	5.2	3.60	3.67	2.68	2.65	2.48	2.45
50 % inorg. Fulvic + Algae	5.0	4.8	3.66	3.74	2.74	2.71	2.54	2.51
50 % inorg.+ humic + Algae	4.5	4.3	3.72	3.79	2.80	2.77	2.60	2.27
25% inorg. alone	8.5	8.3	3.06	3.13	2.07	2.04	1.87	1.84
25% inorg. + F.Y.M. + Algae	8.2	8.0	3.80	3.87	2.86	2.83	2.66	2.63
25% inog. + Compost + Algae	7.9	7.6	3.86	3.93	2.92	2.86	2.72	2.66
25% inorg. Fulvic + Algae	7.6	7.4	3.92	3.99	2.97	2.89	2.77	2.69
25% inorg.+ humic + Alage	7.2	7.0	3.95	4.09	3.01	2.95	2.80	2.77
New L.S.D. at 5%	**0.3**	**0.3**	**0.05**	**0.05**	**0.06**	**0.06**	**0.05**	**0.04**

F.Y.M. = Farmyard manure

Table (4): Effect of using a part of mineral N fertilizer with some organic manure enriched with Spirulina plantensis algae on the percentages of total soluble solids and total acidity, T.S.S./ acid and percentage of reducing sugars in the leaves of Superior grapevines during 2013 & 2014 seasons.

Inorganic and organic manures enriched with Algae treatments	R.S.S. %		Total acidity %		T.S.S. /acid		Reducing sugars %	
	2013	2014	2013	2014	2013	2014	2013	2014
100 % inorganic (inorg.)	16.7	16.5	0.666	0.659	25.1	25.0	14.4	14.7
75% inorg. alone	18.2	18.5	0.636	0.629	28.6	29.4	15.1	15.4
75% inorg. + F.Y.M. + Algae	19.2	19.5	0.569	0.562	33.7	34.7	16.3	16.6
75% inog. + Compost + Algae	19.5	19.8	0.549	0.542	35.5	36.5	16.6	16.9
75% inorg. Fulvic + Algae	19.7	20.0	0.522	0.515	37.7	68.8	16.9	17.0
75% inorg.+ humic + Alage	19.9	20.1	0.501	0.493	39.7	40.8	17.2	17.2
50 % inorg. alone	18.4	18.7	0.615	0.608	29.9	30.8	15.5	15.8
50 %inorg. + F.Y.M. + Algae	20.4	20.7	0.480	0.473	42.5	43.8	17.5	17.8
50 % inog. + Compost + Algae	20.7	21.0	0.459	0.452	45.1	46.5	17.8	18.1
50 % inorg. Fulvic + Algae	21.0	21.3	0.437	0.430	48.1	49.5	18.1	18.4
50 % inorg.+ humic + Algae	21.3	21.6	0.416	0.395	51.2	54.7	18.2	18.5
25% inorg. alone	18.6	18.9	0.591	0.583	31.5	32.4	15.9	16.2
25% inorg. + F.Y.M. + Algae	21.5	21.8	0.396	0.387	54.3	56.3	18.3	18.6
25% inog. + Compost + Algae	21.7	22.0	0.375	0.368	57.9	59.8	18.5	18.7
25% inorg. Fulvic + Algae	22.0	22.3	0.355	0.348	62.0	64.1	18.6	19.0
25% inorg.+ humic + Alage	22.3	22.6	0.335	0.328	66.6	68.9	18.7	19.2
New L.S.D. at 5%	**0.2**	**0.2**	**0.020**	**0.019**	**2.0**	**2.1**	**0.3**	**0.3**

F.Y.M. = Farmyard manure

Table (5): Effect of using a part of mineral N fertilizer with some organic manure enriched with Spirulina plantensis algae on nitrate and nitrite in the juice as well as amount of CO_2 and total counts of bacteria of Superior grapevines during 2013 & 2014 seasons.

Inorganic and organic manures enriched with Algae treatments	Nitrate (ppm)		Nitrite (ppm)		Amount of CO_2 (mg/ 100 g soil)		Total counts of bacteria (cfu)	
	2013	2014	2013	2014	2013	2014	2013	2014
100 % inorganic (inorg.)	9.5	9.0	2.4	2.3	10.1	10.8	3.76	3.86
75% inorg. alone	9.0	8.5	2.2	2.1	11.1	11.8	4.06	4.16
75% inorg. + F.Y.M. + Algae	7.5	7.0	1.6	1.5	15.1	15.8	4.96	5.06
75% inog. + Compost + Algae	7.0	6.5	1.4	1.3	16.2	16.9	5.06	5.16
75% inorg. Fulvic + Algae	6.5	6.0	1.2	1.1	17.3	18.0	5.16	5.16
75% inorg.+ humic + Alage	6.0	5.5	1.2	1.1	18.3	19.0	5.26	5.26
50 % inorg. alone	8.6	8.1	2.0	1.9	12.1	12.8	4.26	4.36
50 %inorg. + F.Y.M. + Algae	5.5	5.0	1.1	1.0	19.4	20.1	5.36	5.36
50 % inog. + Compost + Algae	5.0	4.5	1.1	1.0	20.5	21.2	5.56	5.66
50 % inorg. Fulvic + Algae	4.5	4.0	1.0	0.9	21.6	22.3	5.66	5.66
50 % inorg.+ humic + Algae	4.0	3.5	0.9	0.8	22.7	23.3	5.76	5.76
25% inorg. alone	8.0	7.5	1.8	1.7	14.1	14.8	4.86	4.86
25% inorg. + F.Y.M. + Algae	3.5	3.0	0.8	0.7	23.8	24.5	5.86	5.86
25% inog. + Compost + Algae	3.0	2.5	0.7	0.6	24.9	25.6	6.06	6.06
25% inorg. Fulvic + Algae	2.5	2.0	0.6	0.5	26.0	26.7	6.16	6.26
25% inorg.+ humic + Alage	1.6	1.1	0.5	0.4	27.2	28.0	6.46	6.56
New L.S.D. at 5%	**0.4**	**0.4**	**0.2**	**0.2**	**0.9**	**1.0**	**-**	**-**

F.Y.M. = Farmyard manure

References

Abdelaal, A.H.M.; Ahmed, F.F. Ebrahiem, M.E. and Abdelkareem A.M. (2013): The beneficial effects of some humic acid, EM_1 and weed control treatments on fruiting of Superior grapevines. Stem Cell 4 (3) : 25:32.

Abd El- Kareem, A.M. (2014): The beneficial effects of biofertilization and weed control on fruiting of Superior seedless grapevines. Ph. D. Thesis Fac. of Agric. Minia Univ. Egypt.

Abd El-Malek, Y. and Ishac, Y. Z. (1968): Evaluation of methods used in counting Azotobacter. J. Apple. Bat. 31: 269-275.

Ahmed, F. F.; Abd Elaal, A. M. K. and Masoud, A. A. B. (2012a): Attempts for reducing nitrite pollution in Ruby seedless grapes by using some organic manures enriched with EM. Minufiya J. Agric. Res. Vol. 37 No. 3: 611 - 619.

Ahmed, F. F.; Ragab, M. A.; Merwad, E. A. M. and Mekawy, A. Y.(2012b) Improving productivity of Thompson seedless grapevine by application of some vitamins, humic acid and farmyard manure extract. Minia J. of Asric. Res. & Dev.. 32 (3): 131-145.

Alam, H.M.M. (2014): Productive capacity of Superior grapevines in relation to application of some slow release fertilizers, effective microorganism and humic acid Ph. D. Thesis Fac. of Agric. Minia Univ. Egypt.

Allam-Aida, M. A.; Ahmed, F. F.; El- Hefnawy, N. N.; El- Hewety, M. A. and El- Khafagy, H. A. (2012): Impact of inorganic N and compost enriched with some bacterial strains on fruiting of Superior and Flame seedless grapevines as well as nitrogenase activity in the soil. Minia J. of Agric. Res. & Develop. Vol. (32) No. 3 pp 115 - 130.

Association of Official Agricultural Chemists (2000): Official Methods of Analysis (A.O.A.C), 12th Ed., Benjamin Franklin Station, Washington D.C., U.S.A. pp. 490-510.

Chapman, H.D. and Pratt, P.E. (1987): Methods of Analysis for Soil, Plant and Water. Univ. California, Div. Agric. Sci. 1, 150.

Cochran, W. G. (1950): Estimation of bacterial densities by means of the "most probable Number" Biometrics 6 : 105-116.

Dalbo, M. A. (1992): Nutrition and fertilization of grapevines. Agrapecuaria Catarineneses 5 (4): 32 - 35, Brazil.

Davis, G. and Ghabbour, E. A. (1998): Humic substances, structure properties and uses. Royal Soc. of Chemistry, Cambridge pp. 10 - 15.

El- Khafagy, H.A. (2013): Physiological study on productivity and quality of some grape varieties under bio organic fertilization. Ph. D. Thesis community serving and Environmental studies Instit. Sadat city, Minufiya Univ.

Kannaiyan, S.(2002): Biotechnology of Biofertilizers. Alpha Science International Ltd. Pangabourne England. P. 1-275.

Mead, R.; Currnow, R. N. and Harted, A. M. (1993): Statistics Methods in Agricultural. Biology. 2nd Ed. Chapman & Hall. London. pp.50 - 70.

Rabie, A. M. and Negm, A. A. (2012): Effect of some organic treatments on some grapevine cultivars. Ph. D. Thesis Fac. of Agric. Cairo Univ. Egypt.

Refaai, M. M. (2011): Productive capacity of Thompson seedless grapevines in relation to some inorganic, organic and biofertilization as well as citric acid treatments. Ph. D. Thesis Fac. of Agric. Minia Univ. Egypt.

Ridnour- Lisa, A.; Sim- Julia, E.; Michael, A. H.; David, A. W.; Scan, M. M.; Garry, R. P. and Douglas, R. S. (2000): A spectrophotometric method for the direct and quantitation of Nitric oxide. Nitrite and Nitrate in cell culture Media. Analytical Biochemistry, 281, 223 - 229.

Uwakiem, M. Kh. (2011): Effect of some organic, bio and slow release N fertilizers as well as some antioxidants on vegetative growth, yield and berries quality of Thompson seedless grapevines Ph. D, Thesis. Fac. of Agric. Minia Univ. Egypt.

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