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Article

Yield and Berries Quality of Flame Seedless and Red Globe cvs in Relation to Some Biofertilization Treatments

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Abstract: A field investigation was conducted during 2020 and 2021 seasons on Flame Seedless and Red Globe grapevines *cvs.*, grown in sandy soil located at Malawi district, El-Minia Governorate, Egypt. The examined *cvs* were irrigated by using drip irrigation system and planted at 2 X 3 meters apart. This investigation was focused on the response of Flame Seedless and Red Globe *cvs. to* inoculation with Arbuscular Mycrrohiza Fungi (AMF), Azospirillum bacteria and Azotobacter bacteria individually or in combination. The obtained results show that, when using each micro-organism individually, the effect of AMF on yield and its component as well as berries physical and chemical properties was superior to using Azospirillum or Azotobacter each one individually. The combined inoculation shows more effective than the individual inoculations. The vines of both cultivar inoculating with the three micro-organisms in combination (AMF + Azospirillum + Azotobacter) produced the best yield and berry physical and chemical properties.

Key words: Grapevines, Flame Seedless, Red Globe, Mycrrohiza, Azospirillum, Azotobacter.

1. Introduction

Grapevines (*Vitis vinifera* L.) is one of the oldest fruit crops in the world, it considers as one of the major horticulture crops all over the world (**Doring *et al.*, 2015**). Grapevine has great adaptability in wide range of climatic and soil conditions (**Delas, 2000; Sluys, 2006** and **Ibrahim *et al.*, 2020)**. It growing in wide soil types, from sand to heavy clay, around the temperate bands between 20°C and 50°C Latitude, north or south of the Equator (**Srinivasan and MMullins, 2001**).

Egypt considered as one of leading countries in planting and production of table grape in Africa. However, El-Minia region is one of the leading areas in grapevines cultivation in Egypt, it's got dozens of cultivars, old and newly introduced (**Ibrahim, 2015**). Two red cultivars were chosen for achieving this study.

Flame Seedless *cv.*: it is one of the most popular grape cultivar in Egypt and successfully grown under Egyptian conditions. It ripens early during early June and sometimes in last week of May (in new Egyptian reclamation sandy soils). This cultivar has a great opportunity for export to foreign markets due to good taste and early ripening (**Galet, 2000**). It has a medium berry size, red color, crispy and well balanced flavor. However, in Minia region it faces some problems such as poor yield and poor quality (**Metawie, 2020)**. Red Globe *cv.* it is seedling cultivar that has been introduced in Egypt in the recent years and will adapt under Egyptian conditions. It has a large red berry size, solid crispy pulp and balanced flavor (**Galet, 2000**).

Nowadays, the main interest of scientists is to find natural ways of improving fruit trees growth and productivity that led to environmentally friendly agriculture fertilizers. Biofertilizers have a great potential to achieve this aim, a little information about their application in grapevines growing in Egypt. Then, the current study was given highlighting the role of three micro-organisms (used as bio-fertilizers) namely: Mycrrohiza fungi, Azospirillum and Azotobacter bacteria, on the growth and productivity of four main cultivars of grapevines grown under sandy soil in North Upper Egypt (El-Minia Governorate).

2. Materials and Methods

The current investigation was conducted during two successive seasons 2020 and 2021 on two grapevines cultivars, newly introduced and adapted in Egypt, namely; Flame Seedless and Red Globe. These two cultivars were grown in sandy soil farm, well drained water. The farm which the experiment achievement was located at beside the Cairo-Assiut Western desert rood in front of Malawi district (280 km southern Cairo) El-Minia Governorate – Egypt. The examined *cvs* were irrigated by using drip irrigation system and all mineral fertilizers treatments were applied through the irrigation system. Twenty-four uniforms in vigor vines were selected from each cultivar, planted at 2 X 3 meters apart.

2.1. Plant material

The selected cultivars were 8 years old at the start of experiment. The chosen vines were trained according to cane pruning system using Gable shape supporting system. Vine load was adjusted to 80 eyes per vine (8 fruiting cans × 8 eyes plus 8 renewal spurs × 2 eyes).

2.2. Soil and water analysis

The soil texture where the present experiment was carried out was sandy (table 2). A composite soil and irrigation water samples were collected and subjected to Physical and chemical analysis according to the procedures outlined by **Wilde *et al.* (1985)**, then the data are shown in Table (1).

Table (1). Analysis of orchard soil and irrigation water

Soil analysis		Water analysis	
Constituents	**Values**	**Constituents**	**Values**
Sand %	79.1	**E.C (mmhos/cm/25C)**	1.7
Silt %	11.1	**Hardness**	17.1
Clay %	9.8	**pH**	7.62
Texture	Sandy	**Ca (mg/L)**	42.1
EC (1:2.5 extract) mmhos/cm/ 25 C	2.8	**Mg (mg/L)**	22.3
Organic matter %	0.09	**K (mg/L)**	6.17
pH (1 : 2.5 extract)	8.42	**Na (mg/L)**	77.6
Active lime ($CaCO_3$ %)	9.13%	**Sum of Cations (mg/L)**	9.16
Total N %	0.09	**Alkalinity (mg/L)**	177
Available Phosphorus (ppm)	2.85	**Chlorides (mg/L)**	119
Available Ca (meq/100g)	20.1	**Nitrate (mg/L)**	11.0
Available Mg (meq/100g)	2.03	**Sulphates (mg/L)**	47.9
Available K (meq/100g)	0.57	**Sum of anions (mg/L)**	8.19
C/N Ratio	17.2	**SAR**	2.96

2.3. Preparation of the three micro-organisms strains

The Fungi and bacterial strains used in this study (*Arbuscular mycorrhizal* fungi "AMF", *Azospirillum brasilense* bacteria, *Azotobacter chrococcum* bacteria) were kindly isolated, purified and propagated in the Laboratory of Microbiology, Minia University, Egypt, according to the methods outlined by **Ranganayaki *et al.* (2006)**. Strains of *Azospirillum* or *Azotobacter* were grown on nutrient broth medium on a rotary shaker at 30 °C and 120 rpm. Then the vines were inoculated with culture media after using the suitable dilution. Three inoculation times yearly were applied, at a rate of 200 ml per vine, however each ml contain 10^8 cell of *Azospirillum* or *Azotobacter* bacteria. While, *Arbuscular mycorrhiza* fungi (AMF) developed on onion plants, on its roots. After harvesting the onion plants, the mycrrohiza spore's numbers were microscopeacly examined, and so the number of spores was adjusted at contained 10*8* spores per 1 gram soil. Then, the vines were inoculated three times yearly in terms of 200 g.

The three bio-fertilizers or its combinations were mixed with 1 kg of compost immediately before vines inoculation. The first dose was added during burst bud stage, the second one was added during full blooming stage and the third dose was added at one month later. Eight treatments were applied for each cultivar as followed: Control (un-inoculated vines), Inoculation with (AMF), Inoculation with Azospirillum bacteria, Inoculation with Azotobacter bacteria, Inoculation with AMF + Azospirillum, Inoculation with AMF + Azotobacter, Inoculation with Azospirillum + Azotobacter and Inoculation with AMF + Azospirillum + Azotobacter. Each treatment was replicated three times, one vine per each.

2.4. Yield and physical and chemical properties of berries determination

The yield per vine was recorded in terms of weight (kg) and number of clusters / vine. At harvesting time four clusters were taken random from the yield of each vine and using for determination the following physical and chemical parameters: Average cluster length (cm), average cluster width (cm), average cluster weight (g), average berry weight (g) by using 0.01 sensitivity balance, Berry dimensions (longitudinal and equatorial "cm") were measured by using vernier caliper, juice total soluble solids (TSS%) were achieved by using handy refractometer, percentage of total acidity by titration with 0.1 NaOH (according to **AOAC, 2000**), and percentage of reducing sugar (achieved by using Lane and Eynone volumetric method **Rangana, 1990**).

2.5. Experimental design and Statistical analysis of data

The treatments were arranged in a complete randomized block design (RCBD). Each treatment was replicated three times, one vine per each replicate was used. The obtained data were tabulated and subjected for the statistical analysis. Comparisons between means were made by the least significant differences (New L.S.D) at P= 0.05 (**Snedecore and Cochran, 1990**).

3. Results and Discussion

2.1. Effect of biofertilization on yield and its component

The Statistical analysis carried out on the data of vines production (in terms of yield per vine, clusters number per vine and cluster weight) of Flame Seedless and Red Globe *cvs.* in relation to inoculation with AMF, Azospirillum, and Azotobacter bacteria separately or in-combinations during 2020 and 2021 seasons are displayed in Tables (2 and 3).

3.1.1. Clusters number per vines

The data shows that, during the first season of this study either individually or in combination treatments hadn't any significant effect on the number of clusters per vine of the two cultivars. This seems logical, as the flowering buds initiation and differentiation in grape cultivars takes place during the summer preceding blooming seasons, when the treatments under current study were has not been conducted yet. Contrary, during the second experimental season all treatments with AMF, Azospirillum, and Azotobacter either separated or in combination was capable to significantly increase the number of cluster per vine compared to un-inoculated vines. This finding were true for the two examined cultivars.

3.1.2. Cluster weight (g)

The obtained data shows that the individual inoculation with each one of the three microorganisms was not able to cause any significant increase in the average cluster weight of Red Globe cultivar, during the two experimental seasons. While, only the inoculation with AMF was led to a significant increment in cluster weight during the two experimental seasons of Flame Seedless cultivar.

Regarding the combined inoculations with the three micro-organisms, all combination was capable to significantly increase the average cluster weight (g) of Flame Seedless and Red Globe cultivars, during the two experimented seasons. The obtained data shows also that, the vines inoculated with AMF + Azospirillum + Azotobacter in combination produced the maximized cluster weight (417 & 415 g for Flame Seedless and 812 & 824 g for Red Globe). On the opposite side, untreated vines produced the lowest average cluster weight (339 & 337 g for Flame Seedless *cv.*, 669 & 667 g for Red Globe *cv.*).

Table (2). Effect of inoculation with AMF, Azospirillum and Azotobacter on cluster numbers / vine and cluster weight (g), during 2020 and 2021 seasons

Treatments	**Cluster Numbers/vine**				**Cluster weight (g)**			
	Flame Seedless		**Red Globe**		**Flame Seedless**		**Red Globe**	
	2020	**2021**	**2020**	**2021**	**2020**	**2021**	**2020**	**2021**
Control	15.5	16.5	18.0	17.2	339	337	669	667
AMF	15.7	20.1	19.0	19.5	388	392	692	698
Azospirillum	15.3	19.3	18.8	18.8	341	348	677	675
Azotobacter	14.7	18.4	18.9	18.7	344	351	682	699
AMF + Azospirillum	15.0	20.9	18.3	19.2	399	396	740	759
AMF + Azotobacter	14.3	19.9	19.1	19.0	401	409	763	765
Azospirillum + Azotobacter	15.5	18.7	19.0	18.9	379	377	746	748
AMF + Azospr. + Azotob.	16.3	22.3	20.3	20.7	417	415	812	824
New LSD $_{5\%}$	**NS**	**1.5**	**NS**	**1.3**	**30**	**41**	**51**	**55**

Table (3). Effect of inoculation with AMF, Azospirillum and Azotobacter on yield (kg/vine) and berry weight (g), during 2020 and 2021 seasons

Treatments	Yield (kg/vine)				Berry weight (g)			
	Flame Seedless		Red Globe		Flame Seedless		Red Globe	
	2020	2021	2020	2021	2020	2021	2020	2021
Control	5.25	5.56	12.04	11.47	2.1	2.3	5.4	5.5
AMF	6.09	7.88	13.19	13.61	2.7	2.9	6.1	6.2
Azospirillum	5.22	6.72	12.73	12.69	2.7	2.5	5.6	5.8
Azotobacter	5.06	6.67	12.89	13.07	2.7	2.9	5.9	5.9
AMF + Azospirillum	5.98	8.28	13.54	14.57	3.1	3.1	7.2	7.3
AMF + Azotobacter	5.73	8.14	14.57	14.54	2.7	2.9	7.0	7.4
Azospirillum + Azotobacter	5.87	7.05	14.17	14.14	2.4	2.9	6.4	6.7
AMF + Azospr. + Azotob.	6.80	9.25	16.48	17.06	3.1	3.5	7.8	8.2
New LSD 5%	**1.22**	**1.10**	**1.13**	**2.01**	**0.3**	**0.4**	**0.7**	**0.6**

The positive role of bio-fertilization with role of AMF, Azospirillum and Azotobacter in enhancing the yield and its component, which noticed in this investigation, was in harmony with those obtained by some previous authors on different grapevines cultivars as well as other fruit trees such as: **Carvajal-Munoz & Carmona-Garcia (2012); Mosa *et al.* (2014 & 2018); Ahmed & Ahmed (2020)**; **Hammad *et al.* (2020); Metawe (2020) and Abd El-Rahman and Bakr (2022)**.

3.2. Effect of biofertilization on berry physical properties

3.2.1. Berry weight (g)

The weight of berry significantly affected by the treatments of bio-fertilization treatments. This response was varied from season to other (Table 3). During the first season of this experiment, all treatments lead to a significant effect on increasing berry weight for the Flame Seedless and Red Globe cultivars, except inoculation with Azospirillum bacteria individual and Azotobacter bacteria individually for Red Globe. During the second season of this experiment: all single and combined inoculation with the three examined micro-organisms was able to significantly increase ‘Flame Seedless’ berry weight (g), except the case of individual inoculation with Azospirillum, which was not significantly effective. Regarding the Red Globe cultivar, the individual treatments with Azospirillum and Azotobacter bacteria failed to significantly increase Red Globe berry weight, while individual inoculation with AMF or all combined inoculations led to a significant promotion in berry weight of Flame Seedless and Red Globe cultivars. The obtained data shows that the vines inoculated with the three micro-organisms in combination (AMF + Azospirillum + Azotobacter) produced the highest berry weight of the two *cvs* (3.1 & 3.5 g for Flame Seedless and 7.8 & 8.2 g for Red Globe, during the two seasons respectively. In the contrary, un-inoculated vines produced the lowest berry weight (2.1 & 2.3 g for Flame Seedless *cv.* and 5.4 & 5.5 g for Red Globe *cv.*) in 2020 and 2021 seasons respectively.

3.2.2. Berry equatorial (cm)

The length of berry of the two examined cultivars was significantly affected by the treatments of bio-fertilization by using the individually or combined inoculation with AMF, Azospirillum and Azotobacter bacteria during 2020 and 2021 seasons (Table 4). It is clear from this Table that this response was varied from one year to other. With regard to individual treatments with any of the three examined micro-organisms, individual inoculations with Azospirillum or Azotobacter was not able to cause any significant improvement in berry equatorial of Flame Seedless cultivar, while it had a significant effect on Red Globe berry length in the same season. Regarding the individual inoculation with AM fungi during the first season, it had a significant effect on berry equatorial of the two examined cultivars. Moreover, all combined treatments with the three examined micro-organisms (AMF, Azospirillum, and Azotobacter) led to a significant improvement in berry equatorial during the first experimental season, with the exception of inoculation with Azospirillum + Azotobacter bacteria in combination for Flame Seedless *cv.* Regarding the combined inoculations with the three examined cultivars during the second season, it is clear that any combined inoculation was capable to increase berry equatorial (cm), with the exception of inoculated Flame Seedless cultivar with AMF + Azotobacter and Azospirillum + Azotobacter.

The obtained data declare that the vines inoculated with AMF + Azospirillum + Azotobacter produced the maximized berry equatorial (1.81 & 1.92 cm for Flame Seedless and 3.95 & 4.17 cm for Red Globe). While, non-inoculated vines produced the lowest berry equatorial (1.33 & 1.35 cm for Flame Seedless and 2.72 & 2.74 cm for Red Globe), these findings were true during the two experimental seasons respectively.

3.2.3. Berry diameter (cm)

Berry diameter of the two examined cultivars was significantly enhanced as a result of inoculated the vines with the three bio-fertilizers (AMF, Azospirillum, and Azotobacter bacteria) each one individually or in combination. During the first season, the response of Red Globe *CV.* to bio-fertilizers inoculation was better than Flame Seedless, as all treatments were able to bring about a significant improvement in the diameter of berries compared to control treatment. As for Flame Seedless cultivar during the first season only the individual inoculation with AMF, co-inoculation with AMF + Azospirillum, as well as the combined inoculation with three micro-organisms succeeded in having a positive effect on berry diameter, while the rest treatments failed to improve Flame Seedless berry diameter, during the first season.

Table (4). Effect of inoculation with AMF, Azospirillum and Azotobacter on equatorial and diameter of berry weight (g), during 2020 and 2021 seasons

Treatments	**Berry equatorial (cm)**				**Berry diameter (cm)**			
	Flame Seedless		**Red Globe**		**Flame Seedless**		**Red Globe**	
	2020	**2021**	**2020**	**2021**	**2020**	**2021**	**2020**	**2021**
Control	1.33	1.35	2.72	2.74	1.31	1.32	2.69	2.70
AMF	1.58	1.57	3.21	3.29	1.51	1.52	3.19	3.21
Azospirillum	1.39	1.41	3.12	3.20	1.34	1.36	3.09	3.17
Azotobacter	1.36	1.39	3.07	3.18	1.33	1.38	2.99	3.11
AMF + Azospirillum	1.54	1.57	3.41	3.51	1.54	1.55	3.39	3.48
AMF + Azotobacter	1.45	1.49	3.42	3.48	1.45	1.49	3.41	3.42
Azospirillum + Azotobacter	1.42	1.44	3.31	3.39	1.41	1.42	3.29	3.31
AMF + Azospr. + Azotob.	1.81	1.92	3.95	4.17	1.80	1.89	3.87	4.09
New LSD $_{5\%}$	**0.20**	**0.19**	**0.25**	**0.31**	**0.18**	**0.17**	**0.19**	**0.20**

3.2.4. Berry juice %

The data presented in Table (5) illustrated the impact of bio-fertilization with AMF, Azospirillum and Azotobacter inoculation on berry juice% of Flame Seedless and Red Globe grapevines cultivars, during 2020 and 2021 seasons. The obtained data mentioned that regarding the first season (2020), all treatments failed to significantly varied the juice percentage of the four examined cultivars, either individually or in combinations. On the opposite side, during the second season the response of micro-organisms inoculation was varied. Regarding the Flame Seedless cv., all treatment either individual or combined with the three micro-organisms was capable to increase the percentage of juice in berry. While, inoculated Red Globe *CV*. with AMF individually was capable to significantly increase the berry juice%, while the individual inoculations with Azospirillum or Azotobacter bacteria was failed to do so. In addition, all combined inoculations with the three examined micro-organisms was capable to significantly enhanced the percentage of juice of Red Globe, except the case of inoculated Red Globe with Azospirillum and Azotobacter in combination.

3.3. Effect of bio-fertilization on berry chemical properties

3.3.1. TSS% and TSS/Acidity ratio: It is clear from Table (5) that the combined inoculations between the three micro-organisms were more effective than the individual inoculations. During the first season (2020), all treatments whether individually or in combinations led to a significant increase in the percentage of TSS % in berry juice of Flame Seedless cultivar, except the inoculation with Azotobacter bacteria alone. Concerning the Red Globe cultivar, all bio-fertilizers treatments, either individually or in combination failed to cause any significant increase in the TSS percentage, except the combined inoculation with the three micro-organisms (AMF + Azospirillum + Azotobacter). During the second season, the data shows that all combined treatments were more effective than the individual. Regarding Red Globe cultivar, all combined inoculation with the three micro-organisms was capable to improve the TSS%, contrary all the individual inoculation with any one of the three examined micro-organisms failed to varied the TSS% significantly, during the second season.

Data presented in Table (5) showed that the inoculation with the three examined micro-organisms either individual or in combination had a pronounced effect on the ratio of total soluble solids / total acidity of the two examined cultivars during the two seasons of study. During the first season, inoculated 'Flame Seedless' with Azotobacter bacteria failed to improve TSS/Acidity ratio, contrary the other single or combined inoculations led to significant increase in 'Flame Seedless' TSS/Acidity. Regarding the Red Globe, the individual inoculation with AMF or co-inoculation with AMF + Azospirillum was able to produce a clear and significant increase in TSS/Acidity ratio, while the rest treatments failed to produce any significant promotion, during the first season. During the second season, all treatments, either individually or combined with the three micro-organisms was capable to significantly enhancing the ratio of TSS/Acidity of the two examined cultivars.

Table (5). Effect of inoculation with AMF, Azospirillum and Azotobacter on Juice % and TSS%, during 2020 and 2021 seasons

Treatments	Juice %				TSS %			
	Flame Seedless		Red Globe		Flame Seedless		Red Globe	
	2020	2021	2020	2021	2020	2021	2020	2021
Control	70.2	70.3	68.7	68.3	17.2	17.3	17.2	17.2
AMF	71.2	72.7	79.2	70.4	18.9	19.2	17.4	18.5
Azospirillum	70.8	72.1	68.9	68.7	18.4	18.3	17.5	18.0
Azotobacter	70.6	72.4	69.1	69.9	18.1	18.4	17.8	17.9
AMF + Azospirillum	71.1	73.0	69.9	71.5	19.9	19.9	17.9	18.9
AMF + Azotobacter	71.3	73.2	69.2	70.9	19.2	19.2	17.9	19.0
Azospirillum + Azotobacter	70.5	73.1	68.9	69.8	19.6	19.5	17.2	18.5
AMF + Azospr. + Azotob.	71.1	73.5	69.2	71.9	20.4	20.5	18.8	19.4
New LSD 5%	**NS**	**1.6**	**NS**	**2.1**	**1.2**	**1.3**	**1.5**	**1.7**

3.3.2. Reducing sugars %

Data illustrated in Table (6) shows the response of reducing sugars % of the two examined cultivars (Flame Seedless and Red Globe) to the single or combined inoculations with AM fungi, Azospirillum and Azotobacter bacteria, during 2020 and 2021 seasons. This table clearly shows that, all treatments was capable to improve the reducing sugars percentage of the two cultivars during the two experimental seasons, with the exception of inoculating the Red Globe *cv.* with Azospirillum or Azotobacter individually during 2020 as well as inoculated Red Globe with Azotobacter during the second season. It's clearly shows that all combined inoculation was superior than using each one alone.

3.3.3. Total acidity %

The obtained data demonstrated that, during the first season all single or combined inoculations hasn't any significant effect on total acidity of Flame Seedless cultivar. However, only the combined inoculation with the three micro-organisms (AMF + Azospirillum + Azotobacter) was able to cause a significant decrease in the total acidity of Red Globe cultivar, while the rest of the treatments failed to do so.

During the second season (2021), all treatments succeeded in significantly reducing the total acidity of Red Globe. While, only the combined inoculation with AMF + Azospirillum + Azotobacter was able decrease the total acidity significantly of Flame Seedless cultivar (Table 6).

Table (6). Effect of inoculation with AMF, Azospirillum and Azotobacter on Reducing sugars % and total acidity %, during 2020 and 2021 seasons

Treatments	Reducing sugars %				Total acidity %			
	Flame Seedless		Red Globe		Flame Seedless		Red Globe	
	2020	2021	2020	2021	2020	2021	2020	2021
Control	15.1	15.2	14.7	14.8	0.412	0.421	0.472	0.478
AMF	16.7	17.1	16.5	16.7	0.418	0.405	0.459	0.401
Azospirillum	16.3	16.2	15.3	15.8	0.401	0.405	0.476	0.421
Azotobacter	16.0	16.1	15.2	15.2	0.415	0.417	0.475	0.411
AMF + Azospirillum	17.6	17.5	15.9	15.9	0.412	0.401	0.461	0.397
AMF + Azotobacter	16.8	16.9	15.7	15.8	0.413	0.408	0.366	0.399
Azospirillum + Azotobacter	16.5	16.3	15.9	15.8	0.407	0.418	0.459	0.419
AMF + Azospr. + Azotob.	18.7	18.9	16.8	16.9	0.402	0.375	0.439	0.338
New LSD $_{5\%}$	**0.8**	**0.9**	**1.0**	**0.9**	**NS**	**0.023**	**0.033**	**0.031**

The positive role of bio-fertilization with AMF, AZSB, and AZBB inoculations in increasing TSS % and reducing sugars % as well as decreasing total acidity %, which obtained in the this investigation was in harmony with the findings of some previous authors on different grapevines cultivars and other fruit trees such as those demonstrated by **Ibrahim *et al.* (2009); Carvajal-Munoz & Carmona-Garcia (2012); Belal (2014); Mosa *et al.* (2014 & 2018); Zoran *et al.* (2017); Ahmed & Ahmed (2020) and Hammad *et al.* (2020).**

Bashan and Holguin (1997) concluded that inoculated the grapevines with Azospirillum was more effectiveness when combined with the other microorganisms. However, a synergistic relationship was confirmed between AMF and both Azospirillum and Azotobacter bacteria in the current investigation perhaps due to involving the providing nutrients **(Ibrahim *et al.*, 2009)**, remove inhibitory and facilitate of the process in plant development, such as regulation of plant hormones (**Bashan and Holguin, 1997**). This synergistic effect allows a significant increment can see in facility viability of mineral nutrition of the host (**Bashan *et al.*, 1989 and Bashan & Levanony, 2014**). The enhancement of berry chemical properties as a result of inoculated the vines with AFM inoculation can explained by the role of AMF in contribute to the physiological function of the host plant, and allow assimilate easily of the nutrients from the soil (**Cohen *et al.* (2015**). Similar finding was observed on Red globe grapevines by **Mekawy & Abd El-Hafeez (2020) and Kanitkar (2019)** on 'Thompson Seedless' grapevines.

4. Conclusion

It is strongly recommended to inoculating the Flame Seedless and Red Globe grapevines *cvs.* (Flame Seedless and Red Globe) grown under El-Minia Governorate conditions in sandy soil, and resembling conditions, with AMF, Azospirillum and Azotobacter in combination three times yearly, was very necessary to enhancing the productivity and improving berries physical and chemical properties.

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