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Trials for Controlling Weeds and Improving Fruiting in Red Globe Vineyards

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ABSTRACT

During 2012 and 2013 seasons soil mulching with black polyethylene sheets and sawdust, chemical control with Round up, hand hoeing as well as application of humic acid and Effective Microorganisms (EM1) were examined for their positive action on killing weeds and improving yield and quality of Red Globe grapes. Results revealed that soil mulching with black polyethylene sheets or sawdust, chemical control and hand hoeing either applied alone or in combined with application of humic acid and EM1 was very effective in reducing dry weight of annual weeds and enhancing growth characters, nutrients in the leaves, yield as well as physical and chemical characteristics of the grapes in relative to control. The best means for controlling weeds and improving productivity of the vines was soil mulching with black polyethylene sheets followed by sawdust, hand hoeing and chemical control, in descending order. Controlling weeds by weeds control treatments along with application of humic acid and EM1 was superior than using weed control treatments alone in this respect. Soil mulching with black polyethylene sheets as well as application of humic acid and EM1 each at 5 mL per vine is suggested for controlling weeds and improving productivity of Red Globe vineyards.

Key words: Soil mulching, hand hoeing, chemical control, humic acid, EM1, yield, quality of the berries, red globe grapevines

INTRODUCTION

Extension and improvement of the Egyptian grape industry demands overcoming all production problems. Weed competition is one of these chronic problems. It restricts growth directly and severely limits the ability of grapevines to respond to favourable nutritional and soil moisture conditions, resulting in poor growth and reduced yields (Oran, 1988; Tomasi *et al*., 2001). Controlling of weeds by soil mulching, chemical control and hand hoeing was reviewed by El-Shammaa and Hassan (2001), Erhart and Hartl (2002), Hansen (2005), Yao *et al*. (2005), Dilley (2007), Linjian-Jiang (2010) and Abdelaal (2011). Effective microorganisms (EM1) contains a mixture of lactic acid bacteria, *lactobacillus plantorium*, Candida utilis and *Streptomyces albus* (Higa, 1991). Previous studies showed that using EM1 and Humic acid was very effective in enhancing soil fertility and uptake of elements (Mengel, 1984; Higa, 1995; Wood *et al*., 1997; Simon *et al*., 1999). The promotion effect of EM1 on fruiting was supported by the findings of Bogatyre (2000), Kannaiyan (2002), Farag (2006), Ahmed *et al*. (2012), Allam-Aida *et al*.

(2012) and El-Khafagy (2013). The Results of Omar and Abd El-Aal (2005), Saleh *et al.* (2006), Eman *et al.* (2008), Kabeel *et al.* (2008), Abada (2009), Abd El-Aziz (2011) and Mekawy (2012) emphasized the beneficial effects of humic acid on fruiting of different grapevine cvs.

This experiment was carried out for examining the effect of some weed control, humic acid and EM1 treatments on annual weeds, growth characters, vine nutritional status, yield as well as some physical and chemical characteristics of Red Globe grapes.

MATERIALS AND METHODS

This study was carried out during 2012 and 2013 seasons on 60 uniform in vigour 6 years old Red Globe grapevines grown in a private vineyard located at Matay district, Minia Governorate. The texture of the tested vineyard soil is clay (Table 1). The selected vines are planted at 1.5×3.0 m apart and trained with the cordonic method using Gable supporting system. Vine load was 48 eyes (12 fruiting spurs×3 eyes plus 6 replacement spurs×2 eyes. Surface irrigation system was followed.

All the selected vines received the usual horticultural practices which are commonly used in the vineyard.

This experiment included the following ten treatments:

- Unweeded control
- Unweeded control+humic acid+effective microorganisms (EM1) each at 5 mL vine^{-1}
- Soil mulching with black polyethylene sheets
- Soil mulching with black polyethylene sheets+humic acid+EM1
- Soil mulching with sawdust
- Soil mulching with sawdust+humic acid+EM1
- Chemical control with Round up at 2 L fed^{-1}
- Chemical control with Round up+humic acid+EM1
- Hand hoeing three times
- Hand hoeing three times+humic acid+EM1

Therefore, this experiment included ten treatments, each treatment was replicated three times, two vines per each. Hand hoeing was carried out three times at the first week of March, April and

Table 1: Analysis of the tested soil

Constituents	Values
Sand%	15.0
Silt%	18.5
Clay%	66.5
Texture	Clay
pH (1:2.5 extract)	7.88
O.M%	1.65
$CaCO_3$	1.82
Total N%	0.05
Available P (Olsen method) ppm	4.8
Available K (ammonium acetate) ppm	405.0

Table 2: Weed density (measured as fresh weigh g^{-1} as well as percentages) in the experimental vineyard in 2012 and 2013 seasons just before treatment

	2012		2013	
Weeds name	g^{-1}	%	g^{-1}	%
Cyperus rotundus L.	763.0	39.5	740.0	41.6
Portulaca oleracea L.	360.0	18.7	335.0	18.8
Cynodon dactylon L.	290.0	15.0	275.0	15.4
Corchorus olitorious L.	172.0	08.9	155.0	08.7
Xanthium strumarium L.	135.0	07.0	110.0	06.2
Convolvulus arvensis	120.0	06.2	95.0	05.3
Malva parviflora L.	90.0	04.7	70.0	03.9

May. Black polyethylene sheets (120 micron thick) were used to cover the area around vine trunk and under the vine canopy (0.143 kg m^{-2}). Sawdust mulch was settled in a layer about 15 cm height around vine trunk and under vine canopy (4.4 kg m^{-2}). Round up (glyphosate) as systemic post emergence herbicide at 2 L fed^{-1}. was applied twice at the middle of March and again at one month later and this amount was added to 200 L water fed^{-1}. Humogen (10% humic acid) as a source of humic acid EM1 (1 mL contains 10^7 cells) were applied once via soil just before growth start. This experiment was set up in a randomized complete block design.

The spectrum of annual and perennial weeds infesting the experimental vineyard area was recorded (in m^2) just before the application of different weed control treatments (Table 2). However, the effect of the tested weed control treatments on the associated weeds was evaluated through calculating dry weights of annual weeds per sequre meter.

During both seasons, the following parameters were recorded, dry weight of annual weeds (g), leaf area (cm^2) according to Ahmed and Morsy (1999); main shoot length (cm); leaf content of N, P, K, Mg and Ca (as%) and Zn, Fe, Mn and Cu (as ppm) according to Cottenie *et al.* (1982); berry setting%; No. of clusters $vine^{-1}$; yield (kg), cluster weight (kg) and dimensions (cm), berry weight (g) and dimensions (longitudinal and equatorial in cm); T.S.S%; total sugars% and total acidity% (as g tartaric acid/100 mL juice) (AOAC, 1995).

Statistical analysis was done using new LSD test at 5% (Mead *et al.*, 1993).

RESULTS AND DISCUSSION

Dry weights of annual weeds: It is clear from the data in Table 3 that controlling weeds by soil mulching with black polyethylene sheets or sawdust, chemical control and hand hoeing either alone or in combined with using humic acid and EM1 significantly depressed the dry weights of annual weeds m^{-2} in relative to unweeded control. Controlling the weeds with the studied means along with using humic acid and EM1 was significantly favourable for controlling weeds rather than using weed control treatments alone. Using black polyethylene sheets surpassed the application of sawdust in controlling weeds. Soil mulching was preferable than using any means in this connection/Hand hoeing was superior than using chemical control in this respect. Controlling weeds by soil mulching with polyethylene sheets besides the application of humic acid and EM1 gave the minimum dry weights of annual weeds. Unweeded control gave the maximum values. These results were true during both seasons.

Table 3: Effect of some weed control, humic acid and EM1 treatments on dry weight of annual weeds m^{-2}, leaf area (cm^2) and main shoot length (cm) of red globe grapevines during 2012 and 2013 seasons

Weed control, humic acid (H.A.) and EM1 treatments	Dry weight of annual weeds m^{-2}		Leaf area (cm^2)		Shoot length (cm)	
	2012	2013	2012	2013	2012	2013
Unweeded control	909.0	922.0	122.0	123.1	102.0	107.0
Unweeded control+H.A+EM1	881.0	871.0	124.0	125.1	105.0	110.0
Mulching with black polyethylene sheets	150.0	141.0	144.0	145.3	124.0	130.0
Mulching with black polyethylene+H.A+EM1	111.2	100.0	148.0	149.2	127.0	133.0
Mulching with sawdust	331.0	320.0	138.0	139.3	118.0	123.0
Mulching with sawdust+H.A+EM1	297.0	287.0	141.0	142.2	121.0	127.0
Chemical control with round up	691.0	680.0	133.0	134.2	108.0	113.0
Chemical control with round up+H.A+EM1	661.0	651.0	136.0	137.2	110.0	116.0
Hand hoeing three times	500.5	480.0	127.0	128.3	113.0	117.0
Hand hoeing three times+H.A+EM1	471.0	460.0	129.3	131.0	116.0	120.0
New LSD at 5%	18.0	19.1	01.8	02.1	02.1	02.2

H.A: Humic acid, EM1: Effective microorganisms

Table 4: Effect of some weed control, humic acid and EM1 treatments on percentages of N, P and K in the leaves of red globe grapevines during 2012 and 2013 seasons

Weed control, humic acid (H.A.) and EM1 treatments	Leaf N (%)		Leaf P (%)		Leaf K (%)	
	2012	2013	2012	2013	2012	2013
Unweeded control	1.61	1.66	0.14	0.13	1.24	1.27
Unweeded control+H.A+EM1	1.67	1.72	0.16	0.16	1.27	1.31
Mulching with black polyethylene sheets	2.13	2.18	0.27	0.29	1.52	1.64
Mulching with black polyethylene+H.A+EM1	2.30	2.35	0.30	0.31	1.60	1.68
Mulching with sawdust	1.97	2.02	0.22	0.25	1.41	1.51
Mulching with sawdust+H.A+EM1	2.05	2.10	0.24	0.27	1.47	1.57
Chemical control with round up	1.71	1.76	0.16	0.18	1.27	1.33
Chemical control with round up+H.A+EM1	1.77	1.82	0.18	0.20	1.31	1.38
Hand hoeing three times	1.85	1.91	0.19	0.21	1.36	1.42
Hand hoeing three times+H.A+EM1	1.91	1.97	0.21	0.23	1.41	1.47
New LSD at 5%	0.06	0.05	0.02	0.03	0.03	0.04

H.A: Humic acid, EM1: Effective microorganisms

Growth characters and leaf content of N, P, K, Mg, Ca, Fe, Zn, Mn and Cu: It is clear from the data in Table 3-6 and Fig. 1 that controlling weeds by soil mulching, chemical control and hand hoeing with or without humic acid and EM1 significantly was very effective in stimulating the two growth characters namely leaf area and main shoot length and all nutrients in the leaves (N, P, K, Mg, Ca, Fe, Zn, Mn and Cu) in relative to the check treatment. All weed control treatments (mulching, chemical control or hand hoeing) besides using humic acid and EM1 was superior than using weed control treatments alone in improving growth and vine nutritional status. Using soil mulching for controlling weeds was significantly preferable than using chemical or hand hoeing in this connection. Hand hoeing was preferable than using chemical control in this respect. The maximum values were recorded on the treatment that included soil mulching with black polyethylene sheets plus application of humic acid and EM1. Unweeded control gave the lowest values. Similar results were announced during both seasons.

Table 5: Effect of some weed control, humic acid and EM1 treatments on percentages of Mg and Ca in the leaves of red globe grapevines during 2012 and 2013 seasons

	Leaf (Mg %)		Leaf (Ca%)	
Weed control, humic acid (H.A.) and EM1 treatments	2012	2013	2012	2013
Unweeded control	0.31	0.36	2.91	2.81
Unweeded control+H.A+EM1	0.34	0.39	3.00	2.91
Mulching with black polyethylene sheets	0.68	0.74	3.66	3.55
Mulching with black polyethylene+H.A+EM1	0.72	0.77	3.75	3.66
Mulching with sawdust	0.57	0.62	3.50	3.40
Mulching with sawdust+H.A+EM1	0.64	0.69	3.57	3.47
Chemical control with round up	0.36	0.41	3.11	3.00
Chemical control with round up+H.A+EM1	0.41	0.46	3.22	3.11
Hand hoeing three times	0.46	0.51	3.33	3.23
Hand hoeing three times+H.A+EM1	0.51	0.56	3.45	3.35
New LSD at 5%	0.03	0.04	0.07	0.06

H.A: Humic acid, EM1: Effective microorganisms

Table 6: Effect of some weed control, humic acid and EM1 treatments on some nutrients in the leaves of red globe grapevines during 2012 and 2013 seasons

	Leaf Zn (ppm)		Leaf Fe (ppm)		Leaf Mn (ppm)		Leaf Cu (ppm)	
Weed control, humic acid (H.A.) and EM1 treatments	2012	2013	2012	2013	2012	2013	2012	2013
Unweeded control	70.0	71.1	73.3	79.0	62.0	61.0	22.2	22.0
Unweeded control+H.A+EM1	74.1	75.0	76.0	82.0	64.1	63.0	23.1	22.9
Mulching with black polyethylene sheets	98.0	99.1	92.0	98.0	85.0	84.1	31.9	31.7
Mulching with black polyethylene+H.A+EM1	101.9	103.0	97.0	103.0	88.0	87.1	34.0	33.8
Mulching with sawdust	91.4	92.5	88.0	95.0	78.0	77.1	29.3	29.1
Mulching with sawdust+H.A+EM1	95.0	96.1	91.0	98.0	81.0	80.0	30.5	30.3
Chemical control with round up	77.1	78.0	77.0	83.0	66.2	65.0	24.2	24.0
Chemical control with round up+H.A+EM1	80.0	81.0	81.0	88.0	69.0	68.0	25.3	25.1
Hand hoeing three times	83.3	85.0	82.0	88.0	71.5	70.0	26.6	26.4
Hand hoeing three times+H.A+EM1	87.1	88.0	85.0	91.0	75.0	74.0	27.9	27.7
New LSD at 5%	02.2	02.5	02.4	02.5	02.1	01.9	01.0	00.9

H.A: Humic acid, EM1: Effective microorganisms

Berry setting%, yield and cluster characters: It is revealed from the data in Table 7 and 8 and Fig. 2 and 3 that berry setting%, yield expressed in weight and No. of clusters vine^{-1} and cluster weight and dimensions (length and width) were significantly improved in response to weed control, humic acid and EM1 treatments in relative to unweeded control. Soil mulching (black polyethylene sheets or sawdust), hand hoeing and chemical control, in descending order was significantly very effective in improving berry setting%, yield and cluster characters. Using humic acid and EM1 plus weed control treatments were significantly favourable than using weed control treatments in this respect. Hand hoeing was significantly favourable than chemical control in improving berry setting, yield and cluster characters. These results were true during both seasons.

From economical point of view, the best results with regard to yield were obtained with soil mulching using black polyethylene sheets besides humic acid and EM1. Under such promised

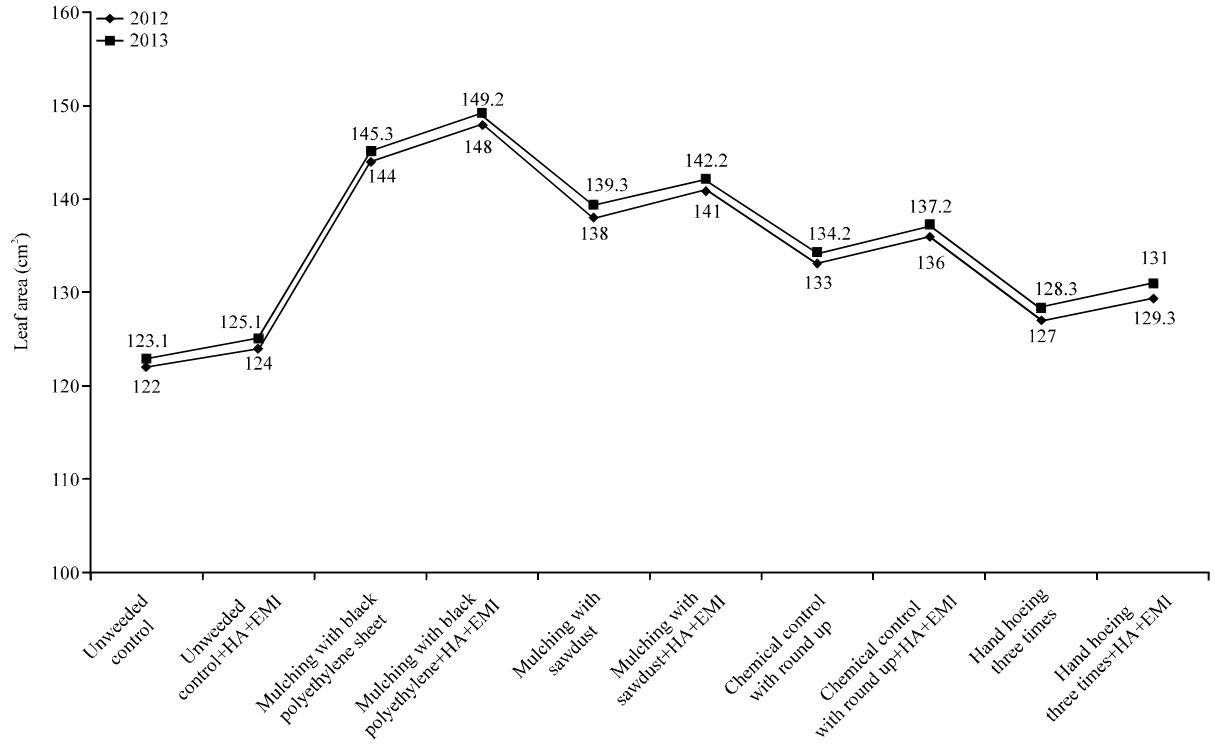

Fig. 1: Effect of some weed control, humic acid and EM1 treatments on leaf area (cm^2) of red

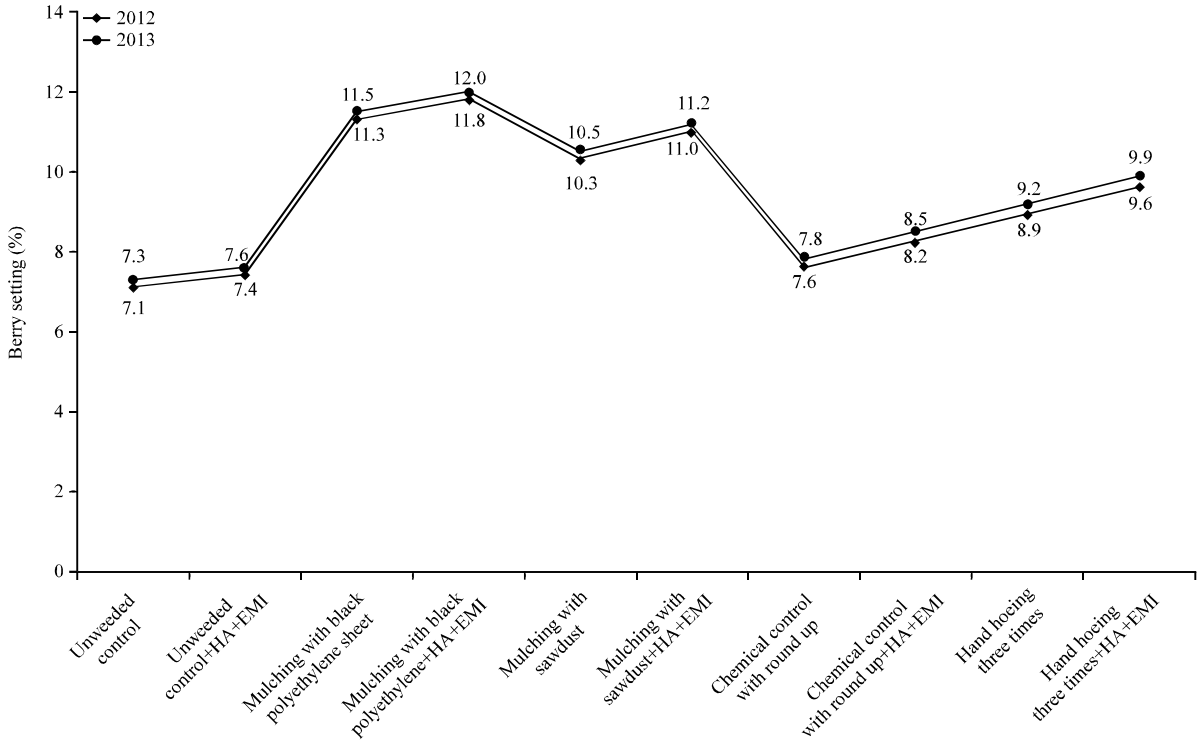

Fig. 2: Effect os some weed control, himic acid and EM1 treatment on berry setting% of red globe grapevines during 2012 and 2013

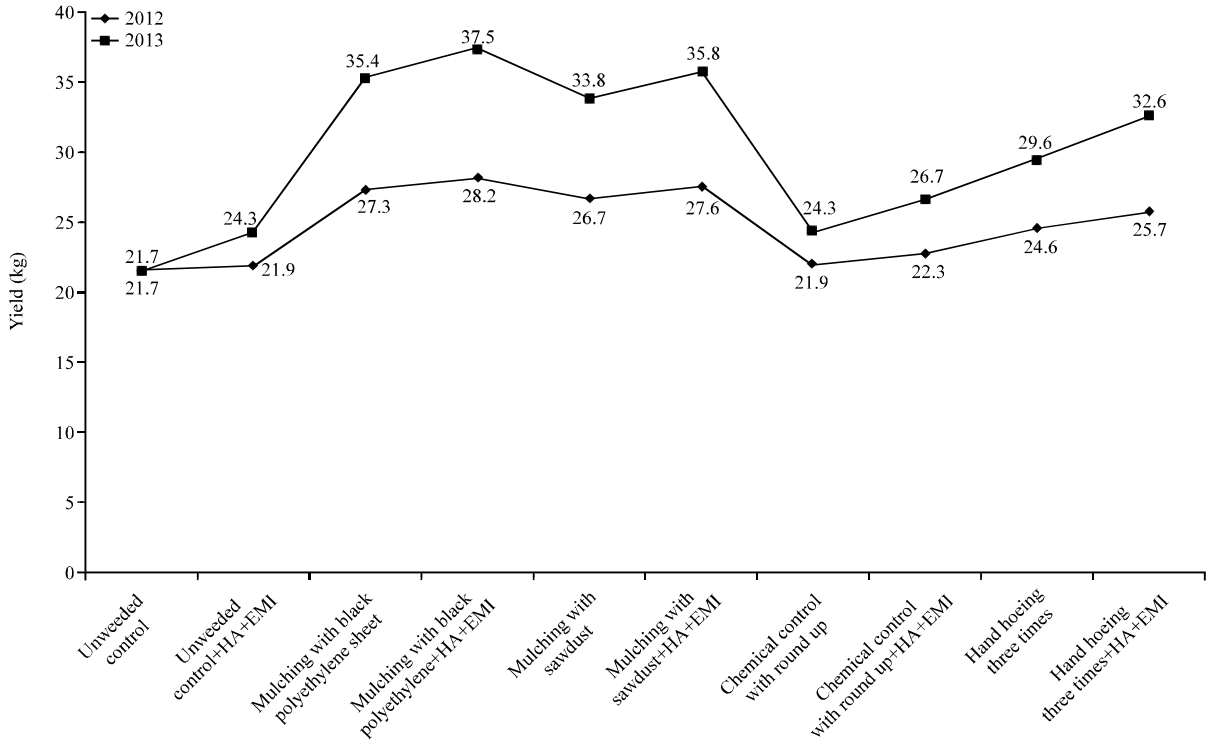

Fig. 3: Effect os some weed control, himic acid and EM1 treatment on yield (kg) of red globe grapevines during 2012 and 2013 seasons

Table 7: Effect of some weed control, humic acid and EM1 treatments on berry setting%, No. of clusters vine^{-1} and yield (kg) of red globe grapevines during 2012 and 2013 seasons

	Berry setting (%)		No. of clusters vine^{-1}		Yield vine^{-1} (kg)	
Weed control, humic acid (H.A.) and EM1 treatments	2012	2013	2012	2013	2012	2013
Unweeded control	07.1	07.3	31.0	31.0	21.7	21.7
Unweeded control+H.A+EM1	07.4	07.6	30.0	33.0	21.9	24.3
Mulching with black polyethylene sheets	11.3	11.5	31.0	40.0	27.3	35.4
Mulching with black polyethylene+H.A+EM1	11.8	12.0	31.0	41.0	28.2	37.5
Mulching with sawdust	10.3	10.5	31.0	39.0	26.7	33.8
Mulching with sawdust+H.A+EM1	11.0	11.2	31.0	40.0	27.6	35.8
Chemical control with round up	07.6	07.8	30.0	33.0	21.9	24.3
Chemical control with round up+H.A+EM1	08.2	08.5	30.0	35.0	22.8	26.7
Hand hoeing three times	08.9	09.2	31.0	37.0	24.6	29.6
Hand hoeing three times+H.A+EM1	09.6	09.9	31.0	39.0	25.7	32.6
New LSD at 5%	00.3	00.4	NS	02.0	01.0	01.3

H.A: Humic acid EM1: Effective microorganisms

treatment, yield per vine (Table 7) reached 28.2 and 37.5 kg compared to 21.7 and 21.7 kg produced by unweeded control per vine during both seasons, respectively. The percentages of increase on the yield over the check treatment reached 29.25 and 72.81% during both seasons, respectively.

Table 8: Effect of some weed control, humic acid and EM1 treatments on some cluster characters of red globe grapevines during 2012 and 2013 seasons

	Cluster weight (g)		Cluster length (cm)		Cluster width (cm)	
Weed control, humic acid (H.A.) and EM1 treatments	2012	2013	2012	2013	2012	2013
Unweeded control	700.0	701.0	20.2	21.2	11.0	11.7
Unweeded control+H.A+EM1	730.0	735.0	20.7	21.9	11.3	12.0
Mulching with black polyethylene sheets	880.0	886.0	24.0	25.1	15.3	16.0
Mulching with black polyethylene+H.A+EM1	910.0	915.0	25.5	26.6	16.9	17.6
Mulching with sawdust	860.0	866.0	23.0	24.0	13.9	14.7
Mulching with sawdust+H.A+EM1	890.0	895.0	23.4	24.5	14.5	15.2
Chemical control with round up	730.0	735.0	21.1	2.1	11.9	12.1
Chemical control with round up+H.A+EM1	761.0	762.0	21.5	22.6	11.9	12.6
Hand hoeing three times	795.0	800.0	22.0	23.0	12.5	13.2
Hand hoeing three times+H.A+EM1	830.0	835.0	22.4	23.7	13.4	14.1
New LSD at 5%	30.0	31.1	00.4	00.3	00.2	00.3

H.A: Humic acid, EM1: Effective microorganisms

Table 9: Effect of some weed control, humic acid and EM1 treatments on some physical characteristics of red globe grapevines during 2012 and 2013 seasons

	Berry weight (g)		Berry longitudinal (cm)		Berry equatorial (cm)	
Weed control, humic acid (H.A.) and EM1 treatments	2012	2013	2012	2013	2012	2013
Unweeded control	08.0	8.6	2.61	2.62	2.51	2.53
Unweeded control+H.A+EM1	08.5	9.1	2.71	2.72	2.62	2.62
Mulching with black polyethylene sheets	12.6	13.3	3.22	3.23	3.12	3.13
Mulching with black polyethylene+H.A+EM1	13.1	13.7	3.27	3.28	3.17	3.18
Mulching with sawdust	11.9	12.6	3.16	3.18	3.07	3.08
Mulching with sawdust+H.A+EM1	12.6	13.2	3.21	3.22	3.11	3.13
Chemical control with round up	09.1	9.8	2.82	2.83	2.72	2.73
Chemical control with round up+H.A+EM1	09.8	10.5	2.92	2.94	2.82	2.83
Hand hoeing three times	10.5	11.1	3.01	3.03	2.91	2.94
Hand hoeing three times+H.A+EM1	11.1	11.7	3.14	3.16	3.04	3.06
New LSD at 5%	00.5	0.4	0.06	0.07	0.05	0.04

H.A: Humic acid, EM1: Effective microorganisms

Some physical and chemical characteristics of the berries: Table 9 and 10 and Fig. 4 and 5 show that controlling weeds by soil mulching with black polyethylene sheets or sawdust, chemical control or hand hoeing with or without using humic acid and EM1 significantly improved quality of the berries in terms of increasing berry weight and dimensions (longitudinal and equatorial), T.S.S% and total sugars% and decreasing total acidity in relative to unweeded control. Mulching was favourable than hand hoeing and chemical control in enhancing fruit quality. The addition of both humic acid and EM1 besides weed control treatments significantly was accompanied with promoting fruit quality rather than application of weed control treatments alone. The best results with regard to quality of the fruits were obtained with controlling weeds by soil mulching with black polyethylene sheets along with using humic acid and EM1. Unfavourable effects on quality of the berries were observed on untreated vines. Similar results were announced during both seasons.

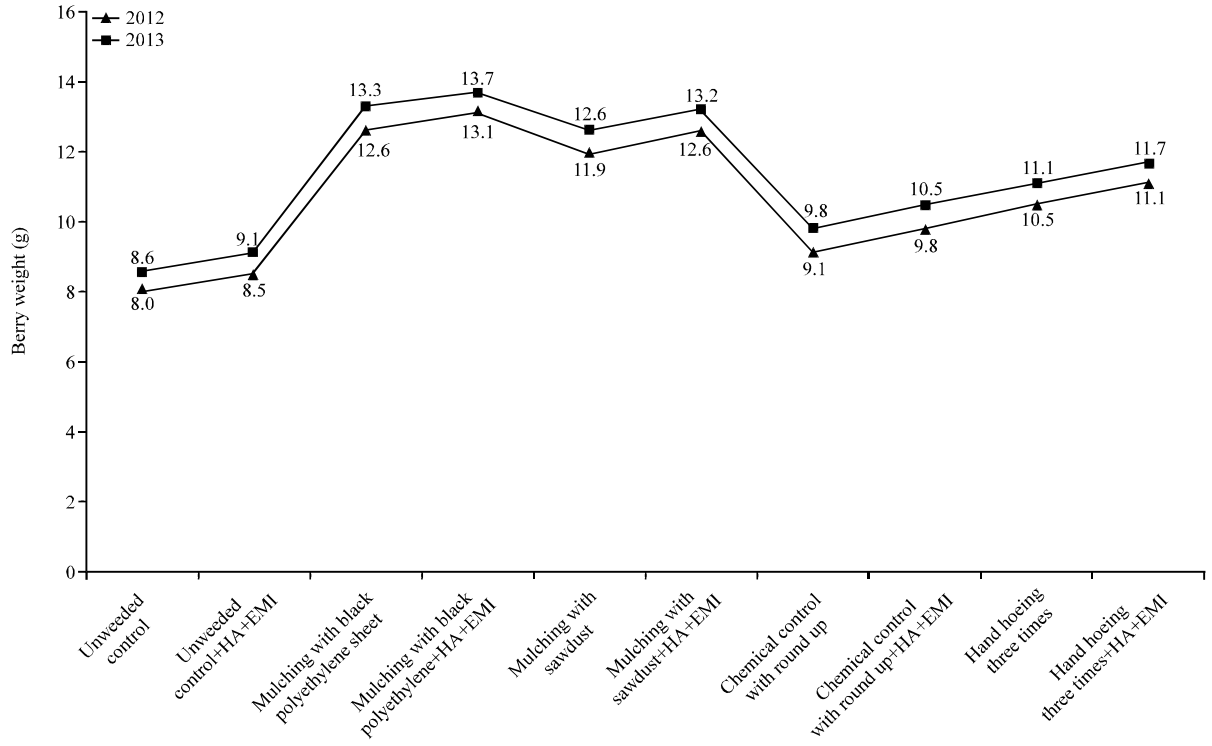

Fig. 4: Effect os some weed control, himic acid and EM1 treatment on berry weight (g) of red globe grapevines during 2012 and 2013 seasons

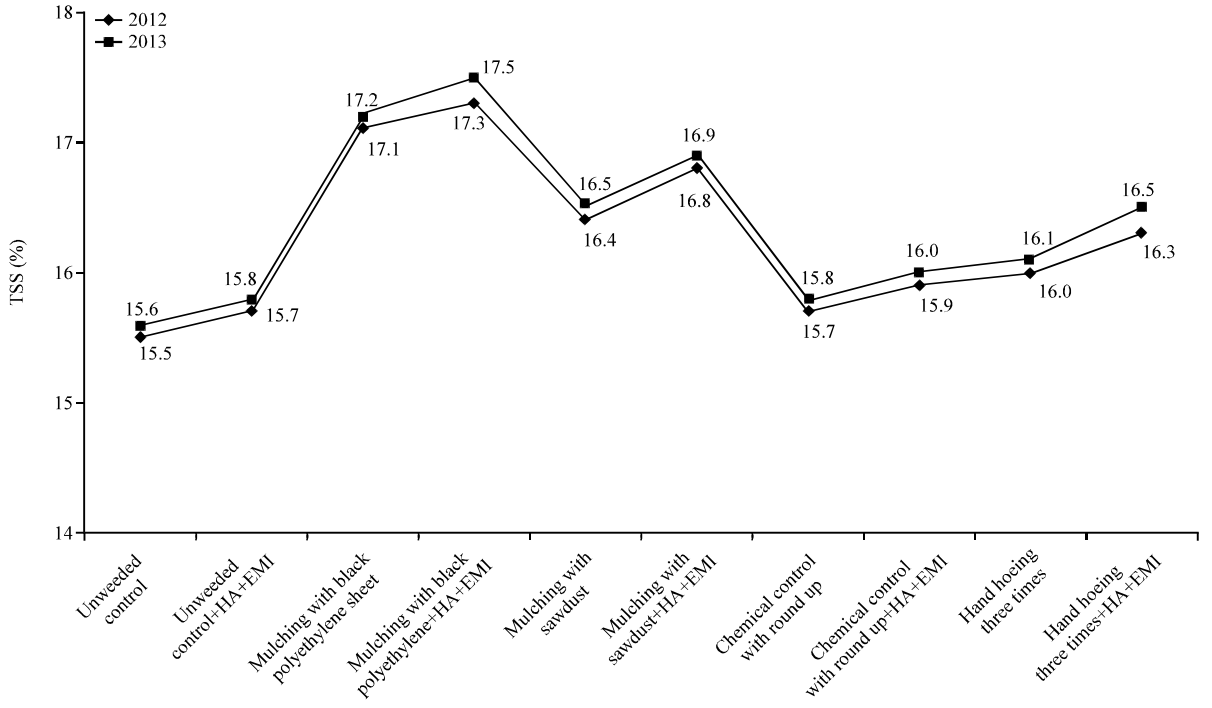

Fig. 5: Effect os some weed control, himic acid and EM1 treatment on percentage of total soluble solides (TSS %) of red globe grapevines during 2012 and 2013 seasons

Table 10: Effect of some weed control, humic acid and EM1 treatments on some chemical characteristics of red globe grapevines during 2012 and 2013 seasons

	T.S.S (%)		Total sugars (%)		Total acidity (%)	
Weed control, humic acid (H.A.) and EM1 treatments	2012	2013	2012	2013	2012	2013
Unweeded control	15.5	15.6	13.5	13.6	0.625	0.631
Unweeded control+H.A+EM1	15.7	15.8	13.7	13.8	0.603	0.606
Mulching with black polyethylene sheets	17.1	17.2	15.5	15.5	0.530	0.488
Mulching with black polyethylene+H.A+EM1	17.3	17.5	15.6	15.7	0.510	0.460
Mulching with sawdust	16.4	16.5	15.0	15.1	0.550	0.520
Mulching with sawdust+H.A+EM1	16.8	16.9	15.2	15.3	0.540	0.491
Chemical control with round up	15.7	15.8	14.0	14.1	0.580	0.582
Chemical control with round up+H.A+EM1	15.9	16.0	14.2	14.3	0.560	0.558
Hand hoeing three times	16.0	16.1	14.5	14.6	0.570	0.530
Hand hoeing three times+H.A+EM1	16.3	16.5	14.8	14.9	0.550	0.510
New LSD at 5%	00.2	00.3	00.3	00.3	0.022	0.024

H.A: Humic acid, EM1: Effective microorganisms

CONCLUSION

Controlling weeds in vineyards was beneficial for protecting the vines from insects and diseases, competition on nutrients, light and water and root damage (Oran, 1988). Therefore, there are many methods of weed control including mulching, chemical control and hand hoeing. The beneficial of mulching for controlling weeds and improving yield and fruit quality of Red Globe grapevines might be attributed to its positive action on conserving soil moisture and changing temperature conditions of the soil and of the air lying just above soil, reducing of soil erosion and reflecting light of the appropriate spectrum (Tomasi *et al*., 2001). These results are in agreement with those obtained by El-Shammaa and Hassan (2001), Erhart and Hartl (2002), Hansen (2005), Yao *et al*. (2005), Dilley (2007), Tesic *et al*. (2007), Derr (2008) and Linjian-Jiang (2010).

The positive action of using EM1and humic acid in improving soil fertility in terms of increasing water retention soil aggregation, soil water content, organic matter, nutrient uptake and activity of microflora and reducing soil pH (Mengel, 1984; Higa, 1995; Wood *et al*., 1997; Simon *et al*., 1999) surely reflected on enhancing growth and fruiting of Red Globe grapevines. These results are in harmony with those obtained by Bogatyre (2000), Kannaiyan (2002), Farag (2006), Ahmed *et al*. (2012), Allam-Aida *et al*. (2012) and El-Khafagy (2013) who worked on EM1, as well as, Omar and Abd El-Aal (2005), Saleh *et al*. (2006), Eman *et al*. (2008), Kabeel *et al*. (2008), Abada (2009), Abd El-Aziz (2011) and Mekawy (2012) who worked on humic acid.

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