Possibility of improving growth, yield and bunch quality of Ruby Seedless grapevines through the application of yeast and summer pruning practice

Ansam S. Abdel-Rahman[1] and Hager I. Tolba[2]

[1]Viticulture Res. Dept., Hort. Res. Instit., Agric. Res. Center, Giza, Egypt
[2]Microbiology Res. Dept., SWE Res. Instit., Agric. Res. Center, Giza, Egypt

Abstract: This investigation was conducted for two successive seasons (2014 and 2015) in a private vineyard located at 58 km Cairo-Alex desert road to find out the effect the application of yeast and summer pruning practice on growth, yield and bunch quality of Ruby Seedless grapevines. The chosen vines were eight-year-old, grown in a sandy loam soil, spaced at 2 X 2.75 meters apart and irrigated by the drip irrigation system. The vines were spur-pruned, trained to the bilateral cordon and trellised according to the "T" shape system. Two doses (10 or 20 L/ fed) of *Saccharomyces cerevisiae* and *Candida tropicalis* were soil drench applied at three application dates: the 1st date (after bud burst), the 2nd date (after shattering) and the 3rd date (4 weeks after shattering). In addition to, summer pruning was applied included pinching the main shoots before the beginning of bloom and maintaining laterals accompanied with defoliation at veraison stage. The results showed that, the inoculation *Saccharomyces cerevisiae* at a rate of 20 L/fed + summer pruning treatment, followed by inoculation with *Candida tropicalis* (20 L/fed) + summer pruning treatment gave the optimum results in comparison with control in both seasons. With respect to microbiological activity in the rhizosphere, it was noticed that the inoculation with *Saccharomyces cerevisiae* and *Candida tropicalis* succeeded to increases the population density of total bacterial and yeast. In addition to increase dehydrogenase enzyme activity and CO_2 evolution in the rhizosphere. In addition to, bio inoculation with *Saccharomyces cerevisiae* or *Candida tropicalis* at a rate of 20 L/fed accompanied with summer pruning resulted in the best yield and its components as well as the best physical properties of bunches, improved the physical and chemical characteristics of berries and ensured the best average leaf area and coefficient of wood ripening. Leaf content of total chlorophyll, cane content of total carbohydrates were also improved. The economical study indicated that bio inoculation with *Saccharomyces cerevisiae* or *Candida tropicalis* at a rate of 20 L/fed accompanied with summer pruning of Ruby Seedless grapevines gave the highest net income as compared to the control.

[Ansam S. Abdel-Rahman and Hager I. Tolba. **Possibility of improving growth, yield and bunch quality of Ruby Seedless grapevines through the application of yeast and summer pruning practice.** *Nat Sci* 2016;14(2):97-106]. ISSN 1545-0740 (print); ISSN 2375-7167 (online). http://www.sciencepub.net/nature. 13. doi:10.7537/marsnsj14021613.

Keywords: yield, grapevines, pinching, summer pruning, yeast, *Saccharomyces* and *Candida.*

1. Introduction

Nowadays, a great attention has been focused on the possibility of using natural and safe agents for promoting growth and yield of crops. Applying bio-fertilization to crops during plant growth stages promoting microorganisms and it is currently considered as a healthy alternative to chemical fertilization. Bio-fertilizers are microbial preparations containing living cells of different microorganisms, which have the ability to mobilize plant nutrients in the soil from unusable to usable form. It is considered environmentally friendly, play a significant role in the crop production, help to build up the lost micro flora and improve the soil fertility **(Zhang *et al.,* 2013)**. In addition, they suppress pathogenic soil organisms, restore natural soil fertility and provide protection against drought and some soil borne diseases. Moreover, they degrade toxic organic chemicals, improve seed germination and aid in balancing soil pH in reducing soil erosion **(Walid *et al.,* 2015).** Yeasts are unicellular fungi that proliferate primarily through asexual means and grow rapidly on simple carbohydrates. Because of their nutritional preference, yeast populations are generally an order of magnitude higher in the rhizosphere as opposed to the bulk soil **(Botha, 2011).** A diverse range of yeasts exhibit plant growth promoting characteristics, including pathogen inhibition (**El-Tarabily and Sivasithamparam, 2006**); stimulation of mycorrhizal- root colonization (**Alonso *et al.,* 2008**) and phytohormone production and phosphate solubilization (**Amprayn *et al.,* 2012**). Yeasts in the root zone may influence plant growth indirectly by encouraging the growth of other plant growth promoting rhizo-microorganisms, through vitamin B12 production (**Medina *et al.*, 2004).** Moreover, Soil drench applications yeast are probably promoting the uptake of different nutrient elements through modifying pH value of the soil solution towards acidity medium that was reflected on plant yield and its components and fruit quality of various grape cultivars **(Esmaeil *et al.,* 2003 and Aisha *et al.,* 2006).**

Summer pruning can be used as a useful means for maintaining vine balance between vegetative growth and productivity. For low to high vigour vineyards, summer pruning on fruit zone and leaf removal may be sufficient to improve the microclimate of the vine **(Freese, 1988).** Many researchers emphasized the necessity of summer pruning for enhancing growth and production of grapes **(Reynolds 1989; Wolf *et al*., 1990; Abd El-Wahab, *et al*., 1997 and Ibrahim *et al*., 2001).**

Ruby seedless cultivar is a late maturing cultivar, ripens though the period from mid to late August, berry oval, color red to purple, seedless, high bud fertility which is reflected on the occurrence of the so-called over cropping phenomenon **(Harry *et al*., 1991).**

The target of this investigation was to study the effect of bio inoculation with *Saccharomyces cerevisiae* and *Candida tropicalis* in combination with summer pruning practice on growth, yield and bunch quality of Ruby Seedless grapevines.

2. Materials and Methods

This investigation was conducted for two successive seasons (2014 & 2015) in a private vineyard located at 58 km Cairo-Alex desert road to find out the effect of yeast inoculation and summer pruning practice on growth, yield and bunch quality of Ruby Seedless grapevines. The chosen vines were eight-year-old, grown in a sandy loam soil (Table, 1), spaced at 2 X 2.75 meters apart and irrigated by the drip irrigation system. The vines were spur-pruned, trained to the bilateral cordon and trellised according to the "T" shape system. The vines were pruned during the third week of January with bud load of (24 buds/vine) resulting in an average of 28-30 clusters/vine. One hundred and twenty uniform vines were chosen. Each four vines acted as a replicate and each three replicates were treated by one of the experiment treatments**.**

Table (1): Physical and chemical analysis of the vineyard soil

Physical	Sand (%)	70.3
	Silt (%)	2.4
	Clay (%)	27.3
	Texture	Sandy loam
Chemical	Organic carbon (%)	0.06
	Organic matter (%)	0.103
	PH	7.75
	EC (Mmhos/cm)	1.45
	Water holding capacity (%)	27.0
	Ca Co_3 (%)	0.6
	N (%)	0.89
	P (%)	0.11
	K (%)	0.54

Microorganisms:

Saccharomyces cerevisiae and *Candida tropicalis* were kindly provided by Microbiology Research Department, Soils, Water and Environment Research Institute, ARC, Giza, Egypt. The strains were grown individual on glucose peptone yeast extract agar (GPY) medium **(Difco, 1985).** The strains were inoculated in 250 ml Erlenmeyer flasks containing 50 ml of liquid glucose peptone yeast extract (GPY) medium. Then, flasks were incubated at 30°C for 48h on a rotary shaker (150) rpm. Yeast inoculants (10^9 CFU/ ml) were added at two rates of 10 and 20 L/ fed. Yeast inoculants were added at three application dates (the 1st date after bud burst, the 2nd date after shattering and the 3rd date 4 weeks after shattering).

Summer pruning was applied included pinching the main shoots before the beginning of bloom and maintaining laterals accompanied with defoliation at veraison stage.

Ten treatments were applied as follows:

1. *Saccharomyces cerevisiae* (10L/fed)
2. *Saccharomyces cerevisiae* (20L/fed)
3. *Candida tropicalis* (10L/fed)
4. *Candida tropicalis* (20L/fed)
5. Summer pruning
6. *Saccharomyces cerevisiae* (10L/fed) + Summer pruning
7. *Saccharomyces cerevisiae* (20L/fed) + Summer pruning
8. *Candida tropicalis* (10L/fed) + Summer pruning
9. *Candida tropicalis* (20L/fed) + Summer pruning
10. Control (Untreated vines).

<u>The following parameters were adopted to evaluate the tested treatments:-</u>

Representative random samples of six bunches/vine were harvested at maturity when TSS reached about 16-17% according to **Tourky *et al*., (1995).**

1. Soil microbiological activity:

Samples of soil were taken from the rhizospheric zone of graps plants roots at two dates: the 1st date (after bud burst) and the 2nd date (after shattering) to recorded population dynamics of total bacterial, yeast count, CO_2 evolution and dehydrogenase activity.

The total bacterial count (CFU×10^6/ g dry soil) and yeast count (CFU×10^4/ g dry soil) were determined by the plate count method according to **Reinhold *et al.* (1985)** using Nutrient ager medium for total bacterial count **(Difco, 1985)** and Glucose Peptone Yeast extract agar (GPY) medium for yeast count **(Difco, 1985);** Dehydrogenase activity (µg TPF/g dry soil/ day) in rhizosphere was determined according to **Skujins (1976)** and CO_2 evolution (mg CO_2/ g dry soil) was determined according to **Gaur *et al.*(1971).**

***2.* Yield and physical characteristics of bunches:**

Yield/vine (kg) was determined as number of bunches/vine X average bunch weight (g). In addition, average bunch weight (g), bunch length and width (cm) were determined.

***3.* Physical characteristics of berries:**

Average berry weight (g), average berry size (cm^3) and average berry dimensions (length and diameter) (cm) were determined.

***4.* Chemical characteristics of berries:**

Total soluble solids in berry juice (TSS %) were determined by hand refractometer and total titratable acidity as tartaric acid (%) as described by AOAC (1985). Hence TSS /acid ratio and total anthocyanin of the berry skin (mg/100g fresh weight) according to **Husia *et al.,* (1965)** were calculated.

***5.* Some characteristics of vegetative growth**

At growth cessation, the following morphological and chemical determinations were carried out on three fruitful shoots / the considered vine:

1- Average leaf area (cm^2) of the apical 5th and 6th leaves using a CI-203- Laser Area-meter made by CID, Inc., Vancouver, USA.

2- Coefficient of wood ripening was calculated by dividing length of the ripened part of the shoot by the total length of the shoot according to **Bouard (1966).**

***6.* Leaf content of total chlorophyll and cane content of total carbohydrates**

1-Leaf content of total chlorophyll (SPAD)

Samples of leaves were taken at full bloom and it's were measured by using nondestructive Minolta chlorophyll meter SPAD 502 of the apical 5th and the 6th leaves **(Wood *et al.,* 1992).**

2-Cane content of total carbohydrates (%)

Samples of canes were taken at winter pruning (during the third week of January) and were measured according to **Smith *et al.*, (1956).**

- **Statistical analysis:**

The complete randomized block design was adopted for the experiment. The statistical analysis of the present data was carried out according to **Snedecor and Cochran (1980).** Averages were compared using the new L.S.D. values at 5% level.

3. Results

***1.* Soil microbial activity:**

Regarding to Table (2) the microbial count was increased after yeast inoculations. The total bacterial count was highly increased after inoculation with *Saccharomyces cerevisiae* (20L/fed) only or plus summer pruning which recorded 198 and 210 CFU×10^6/ g dry soil after the 1st date of sample taking (after bud burst) and the 2nd date of sample taking (after shattering) at 2014 after inoculation with *Saccharomyces cerevisiae* (20L/fed). The corresponding figures for treatment using *Saccharomyces cerevisiae* (20L/fed) plus summer pruning were 200 and 215 CFU×10^6/ g dry soil after, respectively the 1st and 2nd date of sample taking at the first seasons (2014). Moreover, the second season (2015) showed the same trended. On the other hand, the total count of yeast was increased in the treatment inoculated with yeast specially *Saccharomyces cerevisiae* (20 L/ fed) which recorded 39 and 51 CFU×10^4/ g dry soil respectively after the 1st and 2nd date of sample taking at 2014 respectively. Also, the treatment with *Saccharomyces cerevisiae* (20L/fed) plus summer pruning was recorded 41 and 52 CFU×10^4/ g dry soil after the 1st and 2nd date of sample taking at the first seasons (2014). But the treatment with *Candida tropicalis* (20L/fed) was recorded 27 and 39 CFU×10^4/ g dry soil after the 1st and 2nd date of sample taking at 2014 and 31 and 42 CFU×10^4/ g dry soil after the 1st and 2nd date of sample taking at 2015. On the other hand, *Candida tropicalis* (20L/fed) plus summer pruning was recorded 30 and 38 CFU×10^4/ g dry soil after the 1st and 2nd date of sample taking at 2014 and 33 and 46 CFU×10^4/ g dry soil after the 1st and 2nd date of sample taking at 2015. The obtained data also revealed that, dehydrogenase activity was significantly increased after yeasts inoculation as we see in Table 2. For example dehydrogenase recorded the highest increased in treatment with *Saccharomyces cerevisiae* (20L/fed) + Summer pruning which recorded 62 and 75 µg TPF / g dry soil / day after the 1st and 2nd date of sample taking at 2014. And the same trend was seen in the second seasons (2015) with recorded 63 and 77 µg TPF / g dry soil / day after the 1st and 2nd date of sample taking. Moreover, CO_2 evolution was significant increase in most treatments espial in yeast inoculation. The most increased was observed in treatment with *Saccharomyces cerevisiae* (20L/fed) + Summer pruning which recorded 214 and 435 mg CO_2/ g dry soil after the 1st and 2nd date of sample taking at season 2014 . Results showed the same trend at the season 2015 which recorded 224 and 448 mg CO_2/ g dry soil, respectively at the 1st and 2nd date of sample taking.

Table (2): Effect of yeast inoculation and summer pruning practice on microbial counts and some soil enzyme activities in the rhizosphere of Ruby Seedless grapevines in 2014 and 2015 seasons

Treatments	Total bacterial count (CFU×10^6/ g dry soil)				Total yeast (CFU×10^4/ g dry soil)				Dehydrogenase activity (µg TPF/g dry soil/ day)				CO_2 evolution (mg CO_2/ g dry soil)			
	2014		2015		2014		2015		2014		2015		2014		2015	
	1st date	2nd date	1st date	2nd date	1st date	2nd date	1st date	2nd date	1st date	2nd date	1st date	2nd date	1st date	2nd date	1st date	2nd date
***Saccharomyces cerevisiae* (10L/fed)**	170	186	163	179	26	34	27	36	50	58	49	59	156	354	160	362
***Saccharomyces cerevisiae* (20L/fed)**	198	210	189	205	39	51	42	51	58	66	59	70	198	407	203	405
***Candida tropicalis* (10L/fed)**	160	174	167	179	23	37	25	39	48	56	47	57	84	189	88	195
***Candida tropicalis* (20L/fed)**	175	187	171	192	27	39	31	42	57	66	59	66	118	230	124	225
Summer pruning	90	112	96	105	9	12	10	14	38	45	39	47	55	93	58	106
***Saccharomyces cerevisiae* (10L/fed) + Summer pruning**	160	173	167	178	27	32	30	35	50	62	51	66	174	378	180	390
***Saccharomyces cerevisiae* (20L/fed) + Summer pruning**	200	215	189	213	41	52	45	52	62	75	63	77	214	435	224	448
***Candida tropicalis* (10L/fed) +Summer pruning**	153	164	157	172	25	29	27	31	50	56	50	56	99	205	104	209
***Candida tropicalis* (20L/fed) + Summer pruning**	168	179	173	184	30	38	33	46	53	67	55	65	122	247	132	245
Control (Untreated vines)	85	93	87	103	8	11	9	13	25	34	25	32	36	54	42	57
new L.S.D. at (0.05) =	-	-	-	-	-	-	-	-	3	5	2	5	15	21	17	23

2. Yield and physical characteristics of bunches:

Data presented in (Table 3) revealed that yeast inoculants combined with summer pruning treatment succeeded to increase plant yield and it's components. The maximum value of yield was obtained from the inoculations of *Saccharomyces cerevisiae* (20L/fed) in combined with summer pruning treatment, followed by the inoculation of *Candida tropicalis* (20L/fed) combined with summer pruning treatment, while, the lowest values were shown with control in both seasons. The beneficial effect of application treatments on the yield could be ascribed mainly to the increase in bunch weight in the first season and the increase of number of bunches /vine beside the increase in bunch weight in the second season. As for bunch weight, it is positively affected by the conducted treatments in a similar manner to that of yield per vine. With respect to bunch dimensions, bunch length and width were influenced by all treatments; the inoculations of *Saccharomyces cerevisiae* (20L/fed) combined with summer pruning treatment resulted in significantly the highest values of these ones, followed by the inoculations of *Candida tropicalis* (20L/fed) combined with summer pruning treatment, whereas, the lowest values were obtained with control in both seasons.

3. Physical characteristics of berries:

Table (4) showed that physical characteristics of berries i.e. berry weight, size, length and diameter significantly increased by all yeast inoculations and summer pruning treatments. The highest values of those parameters were obtained from the inoculation of *Saccharomyces cerevisiae* (20L/fed) in combined with summer pruning treatment, followed by the inoculations of *Candida tropicalis* (20L/fed) combined with summer pruning treatment, while, the lowest values were obtained from control in both seasons.

4. Chemical characteristics of berries:

Data presented in Table (5) showed that all yeast inoculations and summer pruning treatments improved berry chemical characteristics; i.e. TSS, Acidity, TSS/acid ratio and anthocyanin content of berry skin. The inoculation of *Saccharomyces cerevisiae* (20L/fed) in combined with summer pruning treatment resulted in significantly the highest values of TSS percentage, TSS/acid ratio and anthocyanin content of berry skin and the lowest values of acidity of the berry juice, followed by application the inoculation of *Candida tropicalis* (20L/fed) combined with summer pruning treatment. On the other hand, the lowest values of TSS percentage, TSS/acid ratio and anthocyanin content of berry skin and the highest values of acidity of the juice was obtained from with control in both seasons.

Table (3): Effect of yeast inoculation and summer pruning practice on yield and bunch physical characteristics of Ruby Seedless grapevines in 2014 and 2015 seasons

Characteristics / Treatments	Yield/vine (kg)		No. of bunches		Average bunch weight (g)		Average bunch length (cm)		Average bunch width (cm)	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Saccharomyces cerevisiae (10L/fed)	16.87	18.17	28.0	28.9	602.6	628.6	28.2	28.9	18.6	20.4
Saccharomyces cerevisiae (20L/fed)	18.51	19.92	28.4	29.3	651.7	679.9	28.7	29.2	19.0	20.7
Candida tropicalis (10L/fed)	16.50	17.77	27.9	28.8	591.3	616.8	28.0	28.7	18.5	20.4
Candida tropicalis (20L/fed)	18.24	19.57	28.4	29.2	642.3	670.0	28.5	29.2	18.9	20.7
Summer pruning	16.29	17.48	27.9	28.7	583.7	608.9	27.9	28.7	18.3	20.3
Saccharomyces cerevisiae (10L/fed) + Summer pruning	17.64	18.85	28.3	29.0	623.2	650.1	28.5	29.1	18.7	20.6
Saccharomyces cerevisiae (20L/fed) + Summer pruning	19.58	21.06	28.7	29.6	682.1	711.6	29.1	29.7	19.3	21.2
Candida tropicalis (10L/fed) + Summer pruning	17.22	18.41	28.2	28.9	610.7	637.1	28.3	28.9	18.7	20.5
Candida tropicalis (20L/fed) + Summer pruning	18.91	20.28	28.5	29.3	663.5	692.2	28.8	29.3	19.1	20.9
Control (Untreated vines)	15.77	16.86	27.8	28.5	567.2	591.7	27.7	28.6	18.2	20.1
new L.S.D. at (0.05) =	0.74	0.87	N.S.	0.2	18.3	19.1	0.2	0.3	0.1	0.2

Table (4): Effect of yeast inoculation and summer pruning practice on physical properties of berries of Ruby Seedless grapevines in 2014 and 2015 seasons

Characteristics / Treatments	Average berry weight (g)		Average berry size (cm^3)		Average berry length (cm)		Average berry diameter (cm)	
	2014	2015	2014	2015	2014	2015	2014	2015
Saccharomyces cerevisiae (10L/fed)	3.03	3.13	2.81	2.96	1.74	1.79	1.47	1.49
Saccharomyces cerevisiae (20L/fed)	3.10	3.17	2.85	2.98	1.79	1.83	1.50	1.53
Candida tropicalis (10L/fed)	3.02	3.11	2.81	2.95	1.73	1.78	1.45	1.48
Candida tropicalis (20L/fed)	3.09	3.16	2.85	2.97	1.78	1.83	1.49	1.53
Summer pruning	3.00	3.10	2.79	2.92	1.73	1.77	1.44	1.47
Saccharomyces cerevisiae (10L/fed) + Summer pruning	3.07	3.15	2.84	2.97	1.77	1.82	1.49	1.52
Saccharomyces cerevisiae (20L/fed) + Summer pruning	3.17	3.24	2.91	3.03	1.81	1.87	1.54	1.59
Candida tropicalis (10L/fed) + Summer pruning	3.06	3.15	2.83	2.98	1.75	1.81	1.48	1.51
Candida tropicalis (20L/fed) + Summer pruning	3.13	3.19	2.88	2.99	1.79	1.84	1.51	1.55
Control (Untreated vines)	2.94	2.99	2.74	2.86	1.72	1.75	1.43	1.45
new L.S.D. at (0.05) =	0.03	0.04	0.02	0.03	0.01	0.02	0.02	0.03

5. Some characteristics of vegetative growth

Table (6) showed that average leaf area and coefficient of wood ripening significantly increased by all yeast inoculation and summer pruning treatments. The highest values of those parameters were obtained from the inoculation of *Saccharomyces cerevisiae* (20L/fed) in combined with summer pruning treatment, followed by the inoculation of *Candida tropicalis* (20L/fed) combined with summer pruning treatment while, the lowest values were obtained from control in both seasons.

6. Leaf content of total chlorophyll and cane content of total carbohydrates.

Data presented in (Table 7) showed that all yeast inoculations and summer pruning treatments increased leaf content of total chlorophyll and cane content of total carbohydrates. The inoculation of *Saccharomyces cerevisiae* (20L/fed) in combined with summer pruning treatment resulted in significantly the highest values of those parameters, followed by the inoculation of *Candida tropicalis* (20L/fed) combined with summer pruning treatment whereas, the lowest values were obtained from control in both seasons.

Table (5): Effect of yeast inoculation and summer pruning practice on chemical properties of berries of Ruby Seedless grapevines in 2014 and 2015 seasons

Characteristics / Treatments	TSS (%)		Acidity (%)		TSS/acid ratio		Total anthocyanin (mg/100g F.W.)	
	2014	2015	2014	2015	2014	2015	2014	2015
Saccharomyces cerevisiae (10L/fed)	16.3	16.6	0.65	0.60	25.1	27.7	34.1	35.9
Saccharomyces cerevisiae (20L/fed)	16.6	16.8	0.62	0.57	26.8	29.5	34.8	36.6
Candida tropicalis (10L/fed)	16.3	16.5	0.65	0.61	25.1	27.0	33.8	35.3
Candida tropicalis (20L/fed)	16.6	16.7	0.62	0.58	26.8	28.8	34.7	36.4
Summer pruning	16.2	16.4	0.66	0.61	24.5	26.9	33.5	34.9
Saccharomyces cerevisiae (10L/fed) + Summer pruning	16.5	16.7	0.63	0.58	26.2	28.8	34.5	36.3
Saccharomyces cerevisiae (20L/fed) + Summer pruning	16.9	17.1	0.58	0.52	29.1	32.9	35.3	37.3
Candida tropicalis (10L/fed) + Summer pruning	16.4	16.6	0.64	0.59	25.6	28.1	34.4	36.1
Candida tropicalis (20L/fed) + Summer pruning	16.7	16.8	0.61	0.56	27.4	30.0	35.0	36.9
Control (Untreated vines)	16.1	16.3	0.67	0.63	24.0	25.9	32.9	34.2
new L.S.D. at (0.05) =	0.1	0.2	0.02	0.03	1.4	1.7	0.2	0.3

Table (6): Effect of yeast inoculation and summer pruning practice on some characteristics of vegetative growth of Ruby Seedless grapevines in 2014 and 2015 seasons

Characteristics / Treatments	Average leaf area (cm^2)		Coefficient of wood ripening	
	2014	2015	2014	2015
Saccharomyces cerevisiae (10L/fed)	184.5	187.1	0.85	0.86
Saccharomyces cerevisiae (20L/fed)	185.6	188.0	0.87	0.89
Candida tropicalis (10L/fed)	184.3	187.0	0.84	0.85
Candida tropicalis (20L/fed)	185.4	187.9	0.87	0.88
Summer pruning	183.9	186.7	0.83	0.85
Saccharomyces cerevisiae (10L/fed) + Summer pruning	185.0	187.7	0.86	0.87
Saccharomyces cerevisiae (20L/fed) + Summer pruning	186.1	188.7	0.90	0.93
Candida tropicalis (10L/fed) + Summer pruning	184.8	187.3	0.85	0.87
Candida tropicalis (20L/fed) + Summer pruning	185.7	188.2	0.88	0.90
Control (Untreated vines)	181.7	184.3	0.81	0.84
new L.S.D. at (0.05) =	0.3	0.4	0.01	0.02

Table (7): Effect of yeast inoculation and summer pruning practice on leaf content of total chlorophyll and cane content of total carbohydrates of Ruby Seedless grapevines in 2014 and 2015 seasons

Characteristics Treatments	Leaf total chlorophyll content (SPAD)		Cane total carbohydrates content (%)	
	2014	2015	2014	2015
Saccharomyces cerevisiae (10L/fed)	32.3	33.9	22.6	24.7
Saccharomyces cerevisiae (20L/fed)	32.7	34.6	23.2	25.3
Candida tropicalis (10L/fed)	32.1	33.8	22.6	24.6
Candida tropicalis (20L/fed)	32.6	34.4	23.1	25.1
Summer pruning	32.0	33.6	22.5	24.4
Saccharomyces cerevisiae (10L/fed) + Summer pruning	32.6	34.3	22.9	25.0
Saccharomyces cerevisiae (20L/fed) + Summer pruning	33.2	35.1	23.8	25.9
Candida tropicalis (10L/fed) + Summer pruning	32.4	34.1	22.7	24.9
Candida tropicalis (20L/fed) + Summer pruning	32.9	34.7	23.4	25.4
Control (Untreated vines)	31.7	33.2	22.3	24.1
new L.S.D. at (0.05) =	0.2	0.3	0.3	0.4

7. Economical justification of the recommended treatments (bio inoculation with *Saccharomyces cerevisiae* and *Candida tropicalis* in combined with summer pruning compared with control:

It can be shown from the data presented in Table (8) that bio inoculation with *Saccharomyces cerevisiae* or *Candida tropicalis* at 20 L/fed accompanied with summer pruning gave the maximum net profit compared with the control in both seasons. The very slight raise in the cost of yeasts in combined with summer pruning over control. Hence, it can be anticipated that the added cost of establishment will be offset by an increase in vine productivity.

Table (8): Economical justification of the recommended treatments (bio inoculation with *Saccharomyces cerevisiae* and *Candida tropicalis* in combined with summer pruning) compared with control

Per Feddan	*Saccharomyces cerevisiae* (20L/fed) + Summer pruning	*Candida tropicalis* (20L/fed) + Summer pruning	Control
	2014, season		
Yeast (L) at three dates	60	60	---
Price of yeast (L.E.) at three dates	300	300	---
Labour cost (L.E.)	100	100	---
Labour cost of summer pruning (L.E.)	400	400	
Cost of cultural practices (L.E.)	8000	8000	8000
Total cost (L.E.)	8800	8800	8000
Yield (Kg)	14952	14440	12043
Kg (L.E.)	3.00	3.00	3.00
Yield (L.E.)	44856.0	43321.1	36127.6
The net profit (L.E.)	36056.0	34521.1	28127.6
	2015, season		
Yeast (L) at three dates	60	60	---
Price of yeast (L.E.) at three dates	300	300	---
Labour cost (L.E.)	100	100	---
Labour cost of summer pruning (L.E.)	400	400	
Cost of cultural practices (L.E.)	8500	8500	8500
Total cost (L.E.)	9300	9300	8500
Yield (Kg)	16082	15487	12875
Kg (L.E.)	3.00	3.00	3.00
Yield (L.E.)	48246.5	46459.6	38624.7
The net profit (L.E.)	38946.5	37159.6	30124.7

4. Discussion

In this study, two tested yeast, (*Saccharomyces cerevisiae* and *Candida tropicalis*) were investigated for their role as a plant growth promoting individually or in combination with summer pruning under field conditions. As shown in the results the growth of grape inoculated with yeast in combined with summer pruning gave higher growth and yield in comparison with control treatments. The increase of total microbial count and total yeast count in the rhizosphere of grape plants proved that inoculation with *Saccharomyces cerevisiae* and *Candida tropicalis* increased the soil microbial population **(Botha, 2011).** It was generally believed that microorganisms exert their beneficial effect by producing metabolic activities such as production of amino acids, phyto-hormones and vitamins such B12 (**Morsy *et al.,* 2014**). Concerning the activity of dehydrogenase activity, data cleared a close correlation between activity of dehydrogenase activity and microbial population **(Tolba *et al.,* 2010).** On the other hand, CO_2 evolution was increase after yeast inoculation, it could be attributed to *Saccharomyces cerevisiae* and *Candida tropicalis* enhanced biologically derived CO_2 production were proposed to explain partly the multiple effect of yeast culture **(Nikolay *et al.,* 2001).** These results are in harmony with **Nour and Tolba (2015)** who reported that microbial inoculation of cowpea plants with *Saccharomyces cerevisiae* and *Candida tropicalis* significantly enhanced total bacterial and yeast counts and soil enzymes activities. And **Massoud *et al.* (2015)** who reported that *Saccharomyces cerevisiae* (as plant growth promoters) enhanced and promoted the other native microorganisms to exist and colonize the rhizosphere area of plants and hence the increase of soil fertility and plant productivity. Moreover, the application of growth promoters in from of yeast strains led to improve soil physical, chemical and biological properties result in more release of available nutrient elements to be absorbed by plant roots. This can affect the physiological process such as photosynthesis activity as well as the utilization of carbohydrates and proteins in addition to water use efficiency by different plants (**Metin *et al.,* 2010**). The promoting effect of yeast in increasing cell division and the biosynthesis of organic foods, which reflected in enhancing growth, vine nutritional status, number of clusters/vine, cluster weight could explain the yield increase **(Ahmed and Abd El-Hameed, 2003).** On the other hand, the positive effect of summer pruning on increasing number of bunches/vine and yield can be explained by the temporary cessation of the growth of main shoots and the redistribution of assimilates in winter buds during their formation **(Hunter and Visser, 1988).** Moreover, the promoting effect of yeast as a biofertilizer on the biosynthesis and translocation of carbohydrate surely reflected on improving quality of berries (**Abd El-Hameed, 2005**). These results are harmony with those found by **Esmaeil *et al.* (2003**) on “Roumi Red" cv. that yeast applications as soil drench significantly improved quality of berries and increased bunch weight and yield /vine. But, the increase in berry weight and dimensions observed in summer pruning treatments can be interpreted in view of the fact, which these treatments lead to the increase in photosynthetic activity of leaves. As a consequence of that, immigration of assimilates from leaves towards berries is enhanced **(Winkler, 1965).** These results are in accordance with those obtained by **Abd El-Wahab *et al*. (1997)** and **Ibrahim *et al*. (2001)** who showed that head suckering and pinching the main shoots and maintaining laterals resulted in the highest values of vegetative growth parameters and cane content of total carbohydrates and highest average berry weight, berry size, berry dimensions, average number of bunches/vine, weight of bunches and yield also caused the highest percentages of TSS and TSS/acid ratio and the lowest acidity of berry juice. Although, the promoting effect of yeast on berry chemical properties i.e. TSS% and TSS/acid ratio and the negative effect on acidity% in the grape juice could be attributed to the amino acids play role in the biosynthesis and translocation of sugars and building of anthocyanin pigment in the grape juice **(Ahmed and Abd El-Hameed, 2003).** These results are harmony with those found by **Aisha *et al.* (2006)** on "Flame Seedless" found that yeast applications as soil drench significantly increased TSS% and improved colour of berries. On the other hand, the positive influence of summer pruning treatments on berry chemical properties i.e. TSS%, acidity%, TSS/acid ratio and anthocyanin content of berry skin in the grape juice could be attributed to summer pruning might increase the intensity of photosynthesis in the leaves situated in the section of clusters. This, by its turn, enhanced the immigration of assimilates from leaves towards clusters during the process of ripening **(Ali *et al.*, 2006).** Also, the promotion effect of yeast on vegetative growth parameters could be to that some yeast like *Saccharomyces cerevisiae* have the ability to produce and release various metabolites enhancing the biosynthesis and movement of total carbohydrates as well as their positive action on stimulating both cell division and cell enlargement and stimulating plant growth and their potentialities for improving crop growth, yield and yield components **(Massoud *et al.,* 2014).** This could be explained on the basis that yeasts are capable of indirectly enhancing the plant growth **(El-Tarabily and Sivasithamparam, 2006 and Cloete *et al.,* 2009).** Also, *Saccharomyces sp.* and

Candida sp. can produce the auxin indole-3-acetic acid (IAA) and gibberellins **(El-Tarbily, 2004 and Morsy *et al.,* 2014).** The auxin indole-3-acetic acid is best known for its role in plant cell elongation, division, and differentiation **(Reeta *et al.,* 2010).** Plant performance can also be increased as a result of the production of plant growth regulators compounds includes indole-3-acetic acid, indole-3-pyruvic acid, gibberellins and polyamines by yeasts **(Botha, 2011).** But, the positive influence of summer pruning on increasing vegetative growth can could be attributed to summer pruning might increase the formation of laterals and production of photo synthetically and physiologically efficient leaf area which increased root density **(Hunter and Le-Roux, 1992).** The yeast application could enhance its role in cell division, cell elongation producing more leaf area and thus increasing photosynthesis and producing bioactive substances such as phyto-hormones (**Hussain *et al.*, 2002).** Yeast phytohormone production is assumed to cause the detected changes in root morphology after inoculation which in turn may be related to enhancing mineral uptake like some macro (N, P and K) and micro (Fe, Zn, Mn, Cu…..etc) elements (**Vassilev *et al.,* 2001**).

In conclusion, the results of this study demonstrated the beneficial influence of bio inoculation with *Saccharomyces cerevisiae* and *Candida tropicalis* in combined with summer pruning could be improve growth, yield and bunch quality of Ruby Seedless grapevines under field conditions.

References

1. Abd El-Hameed, H. M. (2005). Response of Red Roomy grapevines to algae extract, yeast and mono potassium phosphate fertilizer. Minia J. of Agric. Res. and Develop. 5 (25): 883-904.
2. Abd El-Wahab, W. A.; Mohamed, S. M. and El-Gendy, R. S. (1997). Effect of summer pruning on bud behaviour and bunch characteristics of Thompson Seedless grapevines. Bull. Fac. Agric. Univ. Cairo, 48: 351-378.
3. Ahmed, A.M. and Abd El-Hameed, H.M. (2003). Growth, uptake of some nutrients and productivity of Red Roomy vines as affected by spraying of some amino acids, Magnesium and boron. Minia J. of Agric. Res. And Develop. 4 (23): 649- 666.
4. Aisha S.A. Gaser, Hanaa A. El-Helw and Abd El-Wahab, M.A. (2006). Effect of yeast doses and time of application on growth, yield and fruit quality of Flame Seedless grapevines. Egypt J. of Appl. Sci., 21 (8B): 661-681.
5. Ali, M. A. K.; El-Gendy, R. S. and El-Morsi, S. (2006). A study on the possibility of improving coloration of Crimson Seedless grapes under desert conditions via the application of some treatments. B- Summer pruning and girdling. Bull. Fac. Agric., Cairo Univ., 57: 723-744.
6. Alonso, L. M.; Kleiner, D. and Ortega, E. (2008). Spores of the mycorrhizal fungus *Glomus mosseae* host yeasts that solubilize phosphate and accumulate polyphosphate. Mycorrhiza, 18: 197-204.
7. Association of Official Agricultural Chemists (1985). Official Methods of Analysis Published by A.O.A.C., Benjamin Franklin Station, Washington DC, USA.
8. Botha, A. (2011). The importance and ecology of yeasts in soil. Soil Biol. Biochem., 43: 1-8.
9. Bouard, J. (1966). Recherches physiologiquessur la vigne et en particulier pour I'aoutment des sarrments. Thesis Sc. Nat Bordeaux-France. pp.34.
10. Cloete, K. J.; A. J. Valentine; M. A. Stander; L. M. Blomerus and A. Botha (2009). Evidence of symbiosis between the soil yeast *Cryptococcus laurentii* and a sclerophyllous medicinal shrub, *Agathosma betulina* (Berg.) Pillans. Microbial Ecol., 57: 624-632.
11. Difco, M. (1985). Dehydrated Culture Media and Reagents for Microbiology, pp. 621. In Difco Loaboratories (Ed.). Incorporated Detroit. Michigan, 48232 USA.
12. El-Tarabily, K. A. (2004). Suppression of *Rhizoctonia solani* diseases of sugar beet by antagonistic and plant growth-promoting yeasts. J. Appl. Microbiol. 96: 69–75.
13. El-Tarabily, K.A. and Sivasithamparam, K. (2006). Potential of yeasts as biocontrol agents of soil-borne fungal plant pathogens and as plant growth promoters. Mycosci., 47: 25–35.
14. Esmaeil, F.H.; M.T. Wahdan and A.F. El-Sheikh (2003). Response of “Thompson Seedless" and "Roumi Red" grape cultivars to foliar sprays with yeast extract and GA3. J. Agric. Sci. Mansoura Univ. 28 (8): 6321-6334.
15. Freese, P.P. (1988). Canopy modification and fruit composition. Proc. Second Int. Symp. Auckland, Newzealand. Nz. Soc. For Vitic. and Qenal pp. 134-136.
16. Gaur, A. C., K. V. Sadasivan, O. P. Vimal and R. S. Mathur (1971). A study of the decomposition of organic matter in an alluvial soil, CO_2 evolution, microbiological and chemical transformations. Plant soil, 35: 17-28.
17. Harry, A.; Fred, J. and Elam, P. (1991). Growing quality table grapes in the home garden. University of California pp. 1-30.
18. Hunter, J.J. and Le-Roux, D.J. (1992). The effect of partial defoliation on development and distribution of roots of *Vitisvi nifera* L cv. Cabernet sauvignon grafted onto rootstock 99 Richter. Am. J. Enol. Vitic. 43: 71- 78.
19. Hunter, J.J. and Visser, J.H. (1988). The effect of partial defoliation, leaf position and developmental stage of the vine on the photosynthetic activity of

Vitisvi nifera L. cv. Cabernet Sauvignon, Afr. J. Enol. Vitic., 10: 67–73.
20. Husia, C.L.; Luh, B.S. and Chichester, C.D. (1965). Anthocyanin in free stone peach. J. Food Science, 30: 5-12.
21. Ibrahim, A. H.; Abd El-Karem, M.A. and Abd EI-Hady, M.A. (2001). Response of Red Roomy grapevines to summer pruning. J. Agric. Sci. Mansoura Univ., 26 (9): 5641-5649.
22. Massoud, O. N.; Ebtsam M. Morsy and Mounira M. Bishara (2015). The promotive effect of N2 fixers, *Bacillus circulans* and *Saccharomyces cerevisiae* on the viability of native arbuscular mycorrhizal fungi and the impact on the productivity of alfalfa (*Medicago sativa* L.) N. Egypt. J. Microbiol., 39: 127- 139.
23. Medina, A; Vassileva, M.; Caravaca, F.; Roldan, A. and Azcon, R. (2004). Improvement of soil characteristics and growth of *Dorycnium pentaphyllum* by amendment with agrowastes and inoculation with AM fungi and/or the yeast *Yarowia lipolytica*. Chemosphere, 56: 449–456.
24. Metin, T. A., G.B. Medine, C. C. Ramazan, O. F. Taskin, and D.Sahin, (2010). The effect of PGPR strain on wheat yield and quality parameters. Proceeding of World Congress of Soil Science, Soil Solutions for a Changing World, pp: 1–6.
25. Morsy Ebtsam M.; El Batanony Nadia H. and O. N. Massoud (2014). Improvement of soybean growth and productivity by inoculation with two yeast species in new reclaimed sandy soil amended with humic acid. African J. Microbiol. Res., 8 (46): 3794- 3803.
26. Nikolay, V.; V. Maria; R. Azcon and M. Almudena (2001). Application of free and Ca-alginate entrapped *Glomusde seticola* and *Yarowia lipolytica* in a soil-plant system. J. Biotecnology, 91: 237-242.
27. Nour, K. A. M. and Hager I. Tolba (2015). Evaluation impact of some plant growth promoting microorganisms on the growth and productivity of cowpea. Middle East Journal of Agriculture Research, 4(3): 532-544.
28. Reeta, P. R.; H. Ally; K. Olga and N. Jennifer (2010). Aberrant Synthesis of Indole-3-Acetic Acid in *Saccharomyces cerevisiae* Triggers Morphogenic Transition, a Virulence Trait of Pathogenic Fungi. Genetics, 185: 211–220.
29. Reinhold, B.; T. Hurek and L. Fendrik (1985). Strain-specific chemotaxis of *Azospirillum* spp. J. Bacteriol., 162:190-195.
30. Reynolds, A.G. (1989). Impact of pruning strategy, cluster thinning and shoot removal on growth, yield and fruit composition of low De Chaunac vines. Canadian J. plant Sci., 69(1): 260-275.
31. Skujins, J. (1976). Extracellular enzymes in soil. CRC Crit. Rev. Microbiol., 4: 383-421.
32. Smith, F., Gilles, M.A., Hamilton, J.K. and Gedess, P.A. (1956). Coloimetric methods for determination of sugar and related substan, Anal. Chem., 28: 350-357.
33. Snedecor, G. W. and Cochran, W.G. (1980). Statistical Methods. 7th ed., The Iowa State Univ. Press. Ames. , Iowa, U.S.A., pp. 593.
34. Tolba, Hager I., Morsy, Ebtsam M. and El-Saida. H. El-badawy (2010). Impact of microbial inoculation on maize (*Zea mays*) productivity under different levels of potassium fertilization. Egypt. J. Biotechnol., 35: 172-184.
35. Tourky, M.N., El-Shahat, S.S. and Rizk, M. H. (1995). Effect of Dormex on fruit set, quality and storage life of Thompson Seedless grapes (Banati grapes) J. Agric. Sci., Mansoura Univ., 20(12): 5139-5151.
36. Young, C.C., P.D. Rekh, W.A. Lai and A.B. Arun, (2006). Encapsulation of plant growth- promoting bacteria in alginate beads enriched with humic acid. Biotechnol Bioeng, 95: 76-83.
37. Vassilev, N., M. Vassileva, R. Azcon, and A. Medina, (2001).Application of free and Ca-alginate-entrapped *Glomusde serticola* and *Yarowia lipolytica* in a soil-plant system. J Biotechnol, 91:237–242.
38. Walid, F.A.M.; Lidia, S.P.; Mateusz, F. and Paweł, T. (2015). The Role of Biofertilization in Improving Apple ProductivityA Review. Advances in Microbiology, 5, 21-27.
39. Winkler, A. (1965). General Viticulture. Univ. Calif. Press, Barkely and Loss Angeles. pp. 633
40. Wolf, T.K.; Zoechlein, B.W.; Cook, M.K. and Coreingham, C.K. (1990): Shoot topping and ethephon effects on White Riesling grapes. Amer. J. Enol. Vitic., 41(4): 330-341.
41. Wood, C.W.; Reeves, D.W. and Himelrick, D.G. (1992). Relationship between chlorophyll meter readings and leaf chlorophyll concentration. N status and crop yield. A review: Proc. Agro. Soc. N.Z. 23: 1-9.
42. Zhang, L.; Zhou, J.; Zhao, Y.G.; Zhai, Y.; Wang, K.; Alva, A.K. and Paramasivam, S. (2013). Optimal Combination of Chemical Compound Fertilizer and Humic Acid to Improve Soil and Leaf Properties, Yield and Quality of Apple (*Malus domestica*). Pakistan Journal of Botany, 45: 1315-1320.

2/21/2016