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Foliar Application of Bread Yeast and Organic Fertilizer to Improve Vegetative Characters of Thompson Seedless Grape Vine (*Vitis vinifera* L.)

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Abstract

The study was conducted during growing season (2015) in a vineyard at Erbil Directorate of Agriculture Researches / Kurdistan Region / Iraq to investigate the possible effects of foliar application of (bio-fertilizer) natural bread yeast (0, 4, 8 and 12g.l^{-1}) and (B&S Pot-min) liquid organic fertilizer (0, 2 and 4ml.l^{-1}) on vegetative growth of (11) years old grapevine cultivar (*Vitis vinifera* L.) cv. Thompson seedless. Results indicated that the concentration of 12 g.l^{-1} of bread yeast increased leaf area and leaf length significantly over other concentrations of bread yeast. Moreover, liquid organic fertilizer at 4ml.l^{-1} caused significant increase in leaf area and leaf length over other concentrations. Interaction between 12g.l^{-1} bread yeast with 4ml.l^{-1} liquid organic fertilizer pointed significant surpass in leaf area and leaf length over other interactions.

Introduction

Grape (*Vitis vinifera* L.) belongs to the Vitaceae family; it is one of the most essential commercial fruit crops of temperate to tropical regions ***[1]***. Due to its high nutritive value, multipurpose use (Table grape, raisin, wine, juice and can) returns becoming more popular ***[2]***. Thompson seedless grapevines are planted throughout the world and are used to produce dried fruits (raisins), and for the fresh market (table grapes), because for a good taste of berries and juice that acceptable for consumers, and it is considered to be the best seedless variety for raisin ***[3]***.

Dry bread yeast (*Saccharomyces cerevisiae*) is a kind of the used bio fertilizers in soil fertilization or in foliar application to improving productivity of fruit crops ***[4]***.It is a natural bio-substance suggested to be useful stimulatory, nutritional and protective functions when it is applied on fruit trees due to its content of hormones, sugars, amino and nucleic acids, vitamins and minerals ***[5]***.

Organic and biofertilizers are more useful and effective comparing of composition with chemicals ***[6]***, Organic fertilization is another option for supplying macro and micro nutrients necessary for plant growth, organic fertilization increased growth and improved nutritional status of grapevines, In addition, the organic materials improve soil structure, aeration and retention of moisture and reduce soil pH ***[7]***.

[8] studied the effect of foliar application of humic acid (0, 1 and 3g.L^{-1}) and bread yeast (0, 2 and 4g.L^{-1}) on some vegetative growth characteristics on grapevine (*Vitis vinifera L.*) cv. Rash-Mew. Results indicated that foliar application of both of bread yeast and humic acid had positive effect on leaf area; shoot length, chlorophyll content as compared to control. ***[9]*** clarified the influence of spraying bread yeast on growth, yield and leaf chemical composition of 12 years old Grapevines (*Vitis vinifera* L.) cv. "superior". Bread yeast at 0.1 and 0.2%. It is obvious from the obtained data that bread yeast significantly improved shoot length, leaf area and chlorophyll content and N% in the leaves.

[10] supplied grapevines cv. Barbera in 2 vineyards and cv. Chardonnay in one vineyard with organic and inorganic fertilizers he found that organic fertilizers resulted in higher K but lower N levels in leaves comparing to inorganic fertilizers. ***[11]*** found that adding chemical and organic fertilizers to grape increased shoot length and leaf area of "Flame Seedless" grapevine (*Vitis vinifera* L.). ***[12]*** on "Crimson seedless" grapevine (*Vitis vinifera* L.) reported that shoot length, leaf area and number of leaves/shoot increased by using organic fertilizers and leaf nutrient content of Zn, Fe and Mn.

The aim of the present study was to investigation the possible effects of foliar application of natural bread yeast (bio-fertilizer) and organic liquid fertilizer (B&S Pot-min) on vegetative growth, yield of Thompson seedless grapevines.

Materials and Methods

This study was carried out in a vineyard at Erbil Directorate of Agriculture Researches / Kurdistan Region / Iraq during growing season (2015) to investigate the possible effects of foliar application of (bio-fertilizer) natural bread yeast (*Saccharomyces cerevisiae*) at 0, 4, 8 and 12g.l^{-1} and liquid organic fertilizer (B&S Pot-min) at 0, 2 and 4ml.l^{-1} on vegetative growth, yield and quality of 11 years old grapevine cultivar (*Vitis vinifera* L.) cv. Thompson seedless. It was trained as arbors (espalier) training, planted at 2 x 4 m apart and pruned at the second week of February to leave (72) eyes/vine (6 fruiting canes with 10 eyes plus 6 renewal spurs with 2 eyes) under drip irrigation. The Physical and chemical analysis of the vineyard soil listed in *(Table: 1)*, soil samples were analyzed according to ***[13]***. Detailed information about the characteristics of climate during the period of the study was recorded in *(Table: 2)*.

Table-1: Physical and chemical analysis of the vineyard soil*

Sample Depth(cm)	***N mg.l^{-1}***	***P mg.l^{-1}***	***K mg.l^{-1}***	***Organic Matter %***	***pH (pH-meter)***	***EC (ds/m)***	***Type of soil***
0-30	56	1.08	358	2.2	7.96	1.15	**Silty clay loam**
30-60	91	0.099	165	1.3	8.01	0.280	**Loamy**
60-90	63	0.22	177	1.2	7.93	0.300	**Silty loam**

***The data analyzed at Erbil director of agriculture researches**

Table -2: Average air temperature, relative humidity and the amount of rain during the period of the study (2015)*

Months	*Average air temperature* °C	*Maximum air temperature* °C	*Minimum air temperature* °C	*Average relative humidity* %	*Average of rain (mm)*
January	8.12	20.36	- 4.13	71.90	28.9
February	10.61	22.33	-1.10	67.84	35.7
March	11.81	24.28	-0.66	63.84	50.6
April	19.44	36.42	2.46	49.43	12.1
May	24.73	39.93	9.52	25.64	--
June	29.47	42.52	16.41	18.72	--
July	33.36	46.42	20.30	14.78	--
August	32.80	46.39	19.20	16.96	--
September	29.01	42.60	15.42	21.05	0.9
October	23.90	37.24	10.55	44.20	25.4
November	13.39	23.64	3.14	66.20	119.1
December	7.76	19.37	-1.84	70.70	84.7

*Source: Meteorological Station of Erbil director agriculture researches

Growth degree days (GDDs) are calculated by taking the average of the daily maximum and minimum temperatures compared to a base temperature, T base, (usually 10 °C). As an equation ***[14]*** and ***[15]***. Bread yeast and liquid organic fertilizer in addition of control (only water) and their interactions were sprayed as foliar application at three times within twenty-one days intervals, starting from 7 days after fruit setting, the second spraying was done during fruit development and the third spraying were done after the veraison stage, Tween-20 at a rate of 0.1% was used with each spray solution as wetting agent. All treatments were replicated four times means that 48 vines. Chemical composition of bread yeast and organic liquid fertilizer showed in table 3 and 4 respectively. Leaf area (cm^2) was measured by taking twenty leaves opposite to the basal clusters according to ***[16]*** equation. Chlorophyll content in leaves were measured in fully maturated leaves by taking randomized twenty leaves opposite to the basal clusters at harvest using digital chlorophyllmeter. Blades of same leaves used for measuring leaf area were discarded and petioles were oven dried at 70^{o} C and grind then 0.5 g weight of each sample was digested using H_2SO_4 and H_2O_2 until clear solution was obtained according to ***[13]***. The digested solutions were quantitatively transfer to 100 ml volumetric flask and completed to 100 ml by distilled water. Thereafter, leaf contents of N, P, and K, were determined.

Results were analyzed statistically according to Factorial Randomized Complete Block Design (RCBD), the data subject to analysis of variance and Duncan's multiple range tests at 5% levels used to differentiate means using SAS program (2005).

Table- 3: Chemical composition of used Bread Yeast (*Saccharomyces cerevisiae*)

No	*Composition of minerals mg.g^{-1}*		*No*	*Amino acids*	*mg.kg^{-1}*
1.	N	20.23	1.	Lysine	5.800
2.	P	21.26	2.	Histidine	7.600
3.	K	47.20	3.	Phenyl alanine	19.900
4.	Mg	2.160	4.	Methionine	4.200
5.	Fe	0.036	5.	Cystine	21.600
6.	Zn	0.210	6.	Glycine	7.810
7.	Cu	0.015	7.	Glutamic	21.600
8.	Si	7.800	8.	Aspartic	16.900
9.	Another compounds		9.	Threonine	14.300
10.	Glyceriizine	3.093 %	10.	Arginine	1.200
11.	Sucrose	1.570 %			
12.	Glucose	3.841 %			
13.	GA	0.620			

Table -4: Chemical composition of used organic liquid fertilizer (B&S Pot-min)*

Content	*Percentage %*
Organic Carbon	30
Organic Nitrogen	0.5
Potassium Oxide	3.1
Total Nitrogen	0.5
Organic matter	48
	mg/kg
Copper	25.35
Nickel	14.27
Zinc	25.53
Chrome	18.78
pH	4.8

Place of origin: Turkey

Result and Discussion

Phenology

Phenology or annual growth cycle for Thompson seedless grapevines and cumulative GDD (°C) were followed from bud break to ripening (*Table: 5)*, when open up 50% of the eyes it is the date of bud break ***[17]***. Either the beginning of flowering is the day on which break up of petal leaves for some of the flower of studied cultivar, blooming is the date of the loss of these petal leaves by more than 75% of the flowers on grapevines and It was also an appointment for harvesting after taking periodic samples every 4-5 days near the maturity of berries to follow-up to prove 100 berries weight which reaches a maximum at full maturity ***[18]***. And also it estimated the quality characteristics of the yield and the proportion of total soluble solids (TSS %) by using the Hand Refractometer and the arrival of this ratio to 17.5 to 18%, is the appropriate percentage to harvest ***[19]***.

Table- 5: Phonological stages and cumulative GDDs during the 2015 growing season.

Phenology	***Time (Day)***	***GDDs (°C)***
Bud break	8- April	0
Flowering	9- May	186
Fruit set	19- May	280
Veraison	5- July	926
Ripening	21- July	603
Average	71	1995

The GDD index from 8 April to 21 July was equal to 1995 GDDs (^{o}C), (Table: 6), thus the study area was classified as Region IV (moderately warm) according to Winkler Index. In fact, it has been demonstrated that canopy development is highly correlated with GDDs [20]. Time from veraison to ripening shortened systematically when the climate became warmer.

Effect of bread yeast on vegetative growth:

Leaf area:

Data in *(Table: 6)* shows that the varying bread yeast concentrations showed significant differences between treatments on leaf area in studied plant leaves if compared with control treatment. Bread yeast treatment at 12g.l^{-1} recorded the highest value (146.9 cm^2). Where, treatment of 4g.l^{-1} recorded the lowest value (133.5 cm^2).

Leaf length:

Data in *(Table: 6)* revealed that leaf length influenced by application of bread yeast, there are significant differences between treatments compared with control treatment. Bread yeast treatment at12g.l^{-1} reached the highest value (17.23 cm) and the lowest value (15.66 cm) scored with concentration of 4g.l^{-1}.

Chlorophyll content in leaves:

As it shown in *(Table: 6)* the bread yeast treatment had no significant effect on total chlorophyll content And Percentage of Nitrogen in studied plant leaves if compared with control treatment.

Phosphorus Percentage:

As showed in *(Table: 6)* were differed significantly on treatments 4, 8 and 12g.l^{-1} and control treatments. While, there are non-significant difference between treatments 4 and 12g.l^{-1}. In the present study the control treatment recorded highest value (0.39%).Whereas, treatment of 8g.l^{-1} recorded lowest value (0.21%).

Potassium Percentage:

In the present study, as shown in *(Table: 6)* the percentage of potassium in leaf petioles bread yeast treatment did not affected significantly on the treatments if compared with control. Increment of leaf area may be attributed to the effect of bread yeast in increasing levels of endogenous hormones, i.e. IAA and GA_3 in treated plants which could be interpreted by cell division and cell elongation. In addition, the physiological roles of vitamins and amino acids in the bread yeast which increased the metabolic processes role and its effect in activating photosynthesis process through enhancing the release of CO_2 ***[21]***: ***[22]*** and ***[23].*** Also, the positive effect of bread yeast may be due to the fact that it is a natural source of cytokinins, vitamins and most essential elements ***[24]***. Also, bread yeast contains natural plant growth promoters specially IAA and cytokinins ***[25]***.

Table- 6: Effect of bread yeast on vegetative growth of "Thompson seedless" grapevines*

Treatments	***Parameters***					
	Leaf area (cm^2)	**Leaf length (cm)**	**Chlorophyll (SPAD)**	**Nitrogen (%)**	**Phosphorus (%)**	**Potassium (%)**
Control (water spray)	143.1 c	16.79 c	35.35 a	1.21 a	0.39 a	0.89a
Bread yeast at 4g.l^{-1}	133.5 d	15.66 d	37.79 a	1.35 a	0.26 b	1.04 a
Bread yeast at 8g.l^{-1}	145.6 b	17.07 b	36.57 a	1.30 a	0.21 c	0.94 a
Bread yeast at 12g.l^{-1}	146.9 a	17.23 a	37.84 a	1.28 a	0.29 b	1.00 a

*Values within each column followed by the same letter are not significantly different from each other according to Duncan's Multiple Range Test at 5% level of probability.

Effect of liquid organic fertilizer on vegetative growth:

Leaf area:

The results showed the significant difference between treatments as a result of liquid organic fertilizer on leaf area in studied plant leaves as obtained in *(Table: 7)* if compared with control treatment, liquid organic fertilizer at 4ml.l^{-1} reached the highest level (144.5 cm^2). While, lowest level recorded by control treatment (140.3 cm^2).

Leaf length:

It clearly revealed that from *(Table: 7)* liquid organic fertilizer given a significant result on leaf length among treatments if compared with control. Liquid organic fertilizer at 4ml.l^{-1} reached the highest value (16.95 cm). Where, control treatment recorded the lowest value (16.46 cm).

Chlorophyll content in leaves:

The results showed that in *(Table: 7)* the effect of liquid organic fertilizer was non-significant on results of total chlorophyll and Percentage of Nitrogen in studied plant leaves if compared with control treatment.

Phosphorus Percentage:

Results showed that in *(Table: 7)* liquid organic fertilizer had significant effects between treatments 2 and 4ml.l^{-1}. Meanwhile, liquid organic fertilizer showed non-significant effects between treatments 2ml.l^{-1} and control.

Potassium Percentage:

The results showed that in *(Table: 7)* the effect of liquid organic fertilizer were non-significant on results of percentage of potassium in studied leaf petioles if compared with control treatment. The beneficial effect of liquid organic fertilizers on leaf area of plants could be related to the improvement of physical conditions of the soil, providing energy from microorganism activity, increasing nutrient supply and improving the efficiency of macro elements as well as its ability to meet some micronutrient requirements ***[26]***; ***[27]*** and **[28]**. It can be explain the effect of this liquid organic fertilizers when spraying on grapevine it due to the increasing of N in the leaves and N will take place to build the porphyrin units which it share for chlorophyll structure because 70% of N that exist in the leaves it play a good roles at chlorophyll structure ***[29]***.

Table- 7: Effect of liquid organic fertilizer on vegetative growth of "Thompson seedless" grapevines*

Treatments	***Parameters***					
	Leaf area (cm2)	**Leaf length (cm)**	**Chlorophyll (SPAD)**	**Nitrogen (%)**	**Phosphorus (%)**	**Potassium (%)**
Control (water spray)	140.3 c	16.46 c	36.47 a	1.26 a	0.31 a	1.06 a
Liquid organic fertilizer at 2ml.l^{-1}	142.0 b	16.66 b	38.11 a	1.29 a	0.30 a	0.92 a
Liquid organic fertilizer at 4ml.l^{-1}	144.5 a	16.95 a	36.08 a	1.30 a	0.26 b	0.93 a

*Values within each column followed by the same letter are not significantly different from each other according to Duncan's Multiple Range Test at 5% level of probability.

Effect of interaction of bread yeast and liquid organic fertilizer on vegetative growth:

Leaf area:

As presented in *(Table: 8)* interaction between factors showed the differences among treatments comparing to control, the more interested result were recorded in interaction between 12g.l^{-1} bread yeast and 4ml.l^{-1} liquid organic fertilizer (153.0 cm^2). Whereas, the lowest level of this parameter were recorded between interaction of 4g.l^{-1} bread yeast and 4ml.l^{-1} liquid organic fertilizer (132.8 cm^2). There are significant differences between overall mean treatments respectively.

Leaf length:

Data presented in *(Table: 8)* clarified that interaction of bread yeast and liquid organic fertilizer had significant effect on leaf length in studied leaves. The most effective treatment was between interactions of 12g.l^{-1}bread yeast and 4ml.l^{-1} liquid organic fertilizer (17.94 cm) and less effective treatment was obtained during interaction of 4g.l^{-1} bread yeast and 4ml.l^{-1} liquid organic fertilizer (15.58 cm.). There are significant differences between overall mean treatments respectively.

Chlorophyll Content in leaves:

As presented in *(Table: 8)* interaction between bread yeast treatments and liquid organic fertilizer treatments showed the differences between some treatments, the more interested result was recorded in interaction between 4g.l^{-1} bread yeast and 2ml.l^{-1} liquid organic fertilizer (40.50 SPAD), and less interested result was recorded with control treatment (32.17 SPAD).

Nitrogen Percentage:

The interaction of studied factors on total Nitrogen in studied leaf petioles as presented in *(Table: 8)* showed difference between interaction of 4g.l^{-1} bread yeast and 4ml.l^{-1} liquid organic fertilizer treatments and control treatment, the more interested result were recorded in interaction between 4g.l^{-1} bread yeast and 4ml.l^{-1} liquid organic fertilizer (1.43%). Where, less interested result was recorded with control (1.08%).

Phosphorus Percentage:

Regarding interaction of both factors, it can be noticed that in *(Table: 8)* combined treatments exhibited significant increase of phosphorus percent of some treatments in studied leaf petioles where the superior treatment was control treatment (0.52%). But lowest value was obtained with interaction of 8g.l^{-1} bread yeast and 2ml.l^{-1} liquid organic fertilizer.

Potassium Percentage:

The effect of interaction of treatments in *(Table: 8)* showed significant difference between 4g.l^{-1} bread yeast with 0ml.l^{-1} liquid organic fertilizer and interaction between 8g.l^{-1} bread yeast with 2ml.l^{-1} liquid organic fertilizer, The interaction was more obvious between concentration of 4g.l^{-1} bread yeast and 0ml.l^{-1} liquid organic fertilizer, which got the highest value (1.25%), and the lowest value was noticed during the interaction of 8g.l^{-1} with 2ml.l^{-1} liquid organic fertilizer (0.77%).

Table- 8: Effect of interaction of bread yeast and liquid organic fertilizer on vegetative growth of "Thompson seedless" grapevines*

Treatments		***Parameters***					
		Leaf area (cm^2)	**Leaf length (cm)**	**Chlorophyll (SPAD)**	**Nitrogen (%)**	**Phosphorus (%)**	**Potassium (%)**
Control (water spray)	**Control (water spray)**	136.8 i	16.05 I	32.17 c	1.08 b	0.52 a	1.03 ab
	Liquid organic fertilizer at 2ml.l^{-1}	141.6 g	16.61 G	37.84 ab	1.23 ab	0.37 b	0.86 ab
	Liquid organic fertilizer at 4ml.l^{-1}	151.0 b	17.72 b	36.05 a-c	1.32 ab	0.28 c	0.79 ab
Bread yeast at 4g.l^{-1}	**Control (water spray)**	133.6 k	15.67 k	38.18 ab	1.29 ab	0.27 c	1.25 a
	Liquid organic fertilizer at 2ml.l^{-1}	134.1 j	15.73 j	40.50 a	1.33 ab	0.27 c	0.93 ab
	Liquid organic fertilizer at 4ml.l^{-1}	132.8 l	15.58 l	34.69 bc	1.43 a	0.25 c	0.93 ab
Bread yeast at 8g.l^{-1}	**Control (water spray)**	146.7 d	17.21 d	38.12 ab	1.33 ab	0.23 c	1.03 ab
	Liquid organic fertilizer at 2ml.l^{-1}	148.9 c	17.46 c	36.11 a-c	1.39 a	0.16 d	0.77 b

	Liquid organic fertilizer at 4ml.l^{-1}	141.1 h	16.55 h	35.48 a-c	1.19 ab	0.26 c	1.02 ab
Bread yeast at 12g.l^{-1}	**Control (water spray)**	144.1 e	16.91 e	37.43 ab	1.34 ab	0.22 c	0.92 ab
	Liquid organic fertilizer at 2ml.l^{-1}	143.6 f	16.85 f	38.00 ab	1.22 ab	0.41 b	1.11 ab
	Liquid organic fertilizer at 4ml.l^{-1}	153.0 a	17.94 a	38.10 ab	1.29 ab	0.24 b	0.98 ab

*Values within each column followed by the same letter are not significantly different from each other according to Duncan's Multiple Range Test at 5% level of probability.

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