Assiut J. Agric. Sci., (48) No. (1-1) 2017 (191-201) *ISSN: 1110-0486*
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Effect of Yeast and Bio-power on Growth and Fruiting of Flame Seedless Grapevines

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Received on: 16/11/2016 **Accepted for publication on:** 19/12/2016

Abstract

This investigation was carried out during 2015 & 2016 seasons, at Afak farm located at Balat district, New Valley Governorate. To study the effect of yeast and bio-power vegetative growth, nutrient status, and fruiting of Flame Seedless grapevines. The experiment was arranged in a complete randomized block design with seven treatments and three replications consisting of two vines per each.

The obtained results could be summarized as follow:

Using the recommended dose of nitrogen (RDN) via 25% mineral plus 75% bio-form significantly increased the number of leaves/shoot and leaf area as well as leaf nutrient composition compared to use RDN via mineral N fertilizer alone. No significant differences on these traits due to use RDN via bio-form plus either 75 or 50% mineral-N. Also, no significant differences on shoot length due to use the double or triple form of fertilization compared to use mineral-N only. All combined fertilization treatments significantly increased the yield and improved the cluster and berry traits compared to use RDN via mineral source only.

It is evident from the foregoing results that double form (50% plus 50% yeast or bio-power) or triple form of fertilization (25% m + 25 or 50% yeast plus 50 or 25% bio-power) improved the vegetative growth, yield and berry quality. In addition, it minimized the production costs and environmental pollution.

***Keywords**: Bio-fertilizers, yield, berry quality, environmental pollution.*

Introduction

Grape (*Vitis vinifera*, L.) is considered as one of the most popular and favorite fruit crops in the world, for being of an excellent flavor, nice taste and high nutritional value. In Egypt, it ranked the second fruit crop after citrus. Due to its high net return, the cultivated area has grown rapidly, especially in the reclaimed lands. It reached about 192934 feddans, the fruitful ones are about 171882 feddans with a total annual production of 1596169 tons according to the statistics of M.A.L.R. (2014). The grapevines require adequate cultural practices, appropriate climatic and soil conditions. Fertilization is one of the most important management to improve the soil fertility and increase crop yield. Nitrogen has a pronounced role to improve production and fruit quality. This fact is fluctuated according to the side of the area, amount applied, the dose as well as the sources and time applied.

Nitrogen has many functions in plant life being part of proteins, an important constituent of protoplasm, responsible for biosynthesis of enzymes, amino acids, plant pigments and encouragement of cell division (Nijjar, 1985 and Mengel and Kirkby, 2001). The relationship between yield, fruit quality and health seems to be a complex and can be influenced by nitrogen fertilization (El-Salhy *et al*., 2013). Continuous use of chemical fertilization leads to the deterioration of soil characteristics and fertility and might lead to the accumulation of metals in plant tissues, affecting the fruit nutritional value and edibility. They not only have harmful effects on the environment but also they are a very great danger that harmful residues may remain in food (Bogatyre, 2000; Shimbo *et al*., 2001 and Keller, 2005).

Controlling chemical fertilization, especially N fertilizer is very important for reducing environmental pollution and obtaining safe produce. Using bio-fertilizers relatively a good method in this respect (El-Haddad *et al*., 1993; Verma, 1999; Ram Rao *et al*., 2007 and El-Salhy *et al*., 2011).

Application of bio-fertilizers containing beneficial micro-organisms instead of synthetic chemicals are known to improve plant growth through the supply of plant nutrients and may help to sustain environmental health and soil productivity. They are known to improve fixation of nutrients in the rhizosphere, produce growth stimulants for plants, improve soil stability, provide biological control, biodegrade substance, recycle nutrients, promote mycorrhiza symbiosis and develop bioremediation process in soil contaminated with toxic, xenobiotic and recalcitrant substances. Additionally, the use of bio-fertilizers can improve productivity per unit area in a relatively short time, consume smaller amounts of energy, mitigate contamination of soil and water, increase soil fertility, and promote autogonism and biological control of phytopathogenic organisms (Shimbo *et al*., 2001; Abdel-Hamid, 2002; Chirinos *et al*., 2006 and El-Salhy *et al*., 2006). Supplying the various grapevine cultivar with bio-fertilizers only or beside mineral-N source caused a pronounced increase in vegetative growth and nutritional status of vines, as well as in yield components, cluster traits and berry quality (Abdel-Hady, 2003; El-Shenawy and Fayd, 2005; Abbas *et al*., 2006; Mostafa, 2008; Abdel-Monem *et al*., 2008;El-Sabagh *et al*, 2011 and El-Salhy *et al*., 2011 and Masoud, 2012).

The yeast is considered as one of promising bio-fertilizer for many crops. Yeast contains a large amount of minerals, proteins, vitamin B and cytokinins. It is very effective for releasing CO_2 which improves net photosynthesis (Idso *et al*., 1995).

Bio-stimulants are biologically active substances, which may contain e.g. hormones proteins and micro-elements and their role is to improve plant growth and development (Jankowski and Dubis, 2008). Bio-fertilizers may help in improving crop productivity and quality by increasing the biological N fixation, the availability and uptake of nutrients, and stimulating the natural hormones (Kannaiyan, 2002).

In this respect, many researchers emphasized the importance of the aforementioned practices to increase the growth and fruiting of grapevines (El-Mogy *et al*., 1998; Esmaeil *et al*., 2003; Gaser *et al*., 2006; El-Salhy *et al*., 2006; Abdel-Monem, 2008; Hegab *et al*., 2010; El-Sabagh *et al*., 2011; El-Salhy *et al*., 2011 and El-Salhy *et al*., 2013).

Therefore, the objective of this investigation was to study the possibility of using bio-fertilization partially instead of completed mineral fertilizers on growth and fruiting of Flame Seedless grapevines.

Materials and Methods

The present study was executed in 2015 and 2016 seasons on Flame Seedless grapevines grown in Afak farm situated at Blat district, New Valley Governorate, Egypt. Soil of the vineyard is silty clay and its some physical and chemical properties were determined according to Wilde *et al*. (1985) and are present in Table (1). The vines were 6 years old at the starting of this experiment and spaced at 1.5x3 meters apart. The vines trained according to the double cordon system and supported with Gable shape. Pruning was carried out at the second week of December by leaving 14 fruiting spurs with 3 buds each spur plus four replacement spurs with 2 buds each. Forty-two healthy vines, with no visual nutrient deficiency symptoms and at almost uniform in their vigor were chosen and divided into seven different treatments including the control. The treatments were as follows:

1- The application of 75% mineral nitrogen plus 25% yeast, as bio-form.

2- The application of 75% mineral nitrogen plus 25% bio-power

3- The application of 50% mineral nitrogen plus 50% yeast.

4- The application of 50% mineral nitrogen plus 50% bio-power.

5- The application of 25% mineral nitrogen plus 50% yeast plus 25% bio-power.

6- The application of 25% mineral nitrogen plus 50% bio-power plus 25% yeast.

7- The application of 100% mineral nitrogen (control).

Table 1. Some physical and chemical properties of the experiment soil.

Soil properties	Values	Soil properties	Values
Sand %	20.0	Total nitrogen	0.19
Silt %	26.0	Available-P (ppm)	5.18
Clay %	54.0	E-c (1:2.5 extract) m mmhas	2.3
Texture grade	Silty clay	K mg/100g	6.6
PH (1:2.5)	7.76	Fe (ppm) DTPA Extractable	7.50
$CaCO_3$ %	1.9	Mn (ppm) DTPA Extractable	5.20
Organic matter %	1.22	Zn (ppm) DTPA Extractable	1.80

Each treatment had under the recommended N level (80g N/vine/year). Urea (46.5% N) as a mineral source was applied at three times: growth start, immediately after berry set and at two months later. The active dry yeast and bio-power as a bio-fertilizer (0.5 to 1.0%) were sprayed twice at growth start and at two month later. The pure dry yeast powder was activated by using sources of carbon and nitrogen with ratio 6:1. This ratio is suitable to get the highest vegetative production of yeast each ml of activated contained about 12000 yeast cells (Barnett *et* *al*., 1990). Bio-power as bio-stimulants that contain amino acids (proteins), nutrients (macro & micro-elements), vitamin and hormones. Solution of yeast and bio-power concentrations were prepared with distilled water and then sprayed. Normal agricultural and horticultural practices used in vineyard (except fertilization) were carried out. The experiment was arranged in a complete randomized block design with three replications consisting of two vines per each.

The following parameters were determined to evaluate the effects of different fertilization treatments on growth, nutrient status, yield and berry quality.

1- Some vegetative growth Parameters:

All vegetative growth traits i.e. main shoot length (cm), number of leves/shoot and leaf area were measured in the middle of July.

The average leaf area (cm^2): Twenty leaves from those opposite to basal clusters were measured according to the following equation that was reported by Ahmed and Morsy (1999) leaf area = 0.56 (0.79 x w2) + 20.01, where, w = the maximum leaf width.

2- Leaf nutritional status:

Samples of 30 leaves for each replication were collected from the first full mature leaves from the top of shoots in mid of July and leaf petioles were separated from the blades. The petioles were washed with tap water, distilled water, air-dried, oven-dried at 70°C to constant weight, then ground in a stainless steel mill. Wet digestion was done by using concentrated sulphoric acid and hydrogen peroxide for overnight. Percentages of N, P and K (on dry weight basis) were determined in the digestion according Wilde *et al*. (1985).

3- Yield:

At harvest date, the yield per vine was recorded in terms of weight (kg) and number of clusters per vine.

4- Cluster and berry characteristic:

At harvest time, two clusters were randomly taken from the yield of each vine to determine the cluster and berry traits such as cluster weight and cluster compactness coefficient. Berry quality such as berry weight, reducing sugar percentages, total soluble solids and total acidity (expressed as gm tartaric acid per 100 ml juice), berry properties were evaluated according to A.O.A.C. methods (1985). In addition, the anthocyanin content was determined according to Markham (1982). All the obtained data were tabulated and analyzed according to Gomez and Gomez, (1984) using L.S.D. test for distinguishing the significance differences between various treatment means according to Steel and Torrie (1980).

Results

1- Vegetative growth and leaf nutritional status:

Data presented in Tables (2 & 3) showed the effect of yeast or bio-stimulants as a bio-fertilization on shoot length and number of leaves/shoot and leaf area as well as leaf N, P & K% of Flame Seedless grapevines during 2015 and 2016 seasons. It is obvious from the data that the results took similar trend during the two studied seasons.

In a general view, data in prementioned tables showed that the application of the required N through using 75 or 50% of the recommended dose of nitrogen (RDN) as mineral N along with using 25 or 50% as yeast or bio-power form significantly increased such traits excepted shoot length compared to using RDN only as a mineral N fertilizer. The promotion on such growth traits was associated with increasing the applied level of the bioform from 25 to 50%. Moreover, applications of the suitable amount of N via 25% as a mineral N plus 75% bio-form significantly stimulated the leaves number/shoot and leaf area as well as N, P and K contents of leaves more than 75% mineral N plus 25% bio-form. The maximum values of shoot length and leaf traits were recorded on the vines that were fertilized with the required N as 25% in a mineral N along 25% yeast plus 50% bio-power. On other hand, the lowest values of the growth traits as well as N, P and K contents were recorded for the vines that were treated with 100% mineral N (check trees). The highest leaf area was (169.4 & 177.5 cm^2) and (171.5 & 179.6 cm^2) due to use 25% mineral plus 50% yeast along 25% bio-power (T_5) and 25% mineral plus 25% yeast along 50% bio-power (T_6) during the two studied seasons, respectively. On other hand, the lowest ones due to use 100% mineral-N (control, T_7) was (154.6 & 163.5 cm^2) during the two studied seasons, respectively. Then, the increment percentage of the leaf area was (9.57 & 8.56%) and (10.93 & 9.85%) due to T_5 and T_6 compared to the check treatment (T_7), respectively. Also, the highest N% were (1.45 & 1.53%) and (1.47 & 1.55%) due to T_5 and T_6 against lowest ones (1.34 & 1.41%) due to 100mineral-N (control). Hence, the increment percentage of N% due to T_5 and T_6 over control attained (8.21 & 8.51%) and (9.70 & 9.92%). Therefore, N fertilization with bio-sources as a partial substitute for mineral ones significantly increased the total leaf surface area, nutritional status and vegetative growth of vines as well as decreased the opportunity of the environmental pollution.

2- Yield and cluster characteristics:

Data presented in Table (4) showed that the number of clusters per vine on 2015 season did not alter with varying the fertilization treatments. On the other studied season, using nitrogen fertilization as double form (mineral-plus bio) or triple form (mineral + yeast and bio-power) significantly increased the cluster numbers/vine compared to application of N as 100% via mineral fertilization. Using whatever yeast or bio-power plus mineral-N significantly caused a remarkable promotion on cluster weight and yield/vine compared to using RDN via mineral source only. On other hand, no significant effects on compactness coefficient as influenced by using combined fertilization. Moreover, fertilized by combined at the three forms gave the highest values of these traits and least values of compactness coefficient comparing with other fertilization treatment. The obtained highest of cluster weight values were (350.4 & 383.2 g) and (357.8 & 390.6 g) and yield/vine (9.85 & 12.72 kg) and (10.13 & 13.40 kg/vine) due to fertilize by 25% m plus 50% yeast and 25% bio-power, T_5 or 25% m plus 25% yeast and 50% bio-power, T_6 during the two studied seasons, respectively. Contrarly, these values on check vines were (289.8 & 315.6 g) and (7.97 & 9.06 kg/vine), respectively. Hence the corresponding increment percentages for these traits over check treatment were (20.91 & 21.42%) and (23.46 & 23.76%) as well as (23.59 & 27.10%) and (40.49 & 47.90%), respectively.

In general, it could be concluded that combined the bio-fertilization with mineral-N fertilization had increasing effects on productivity of Flame seedless grapevines.

3- Berry quality:

It can be concluded from data in Table (5) that bio-fertilization in combination with mineral-N significantly increased the berry weight compared to use mineral only. The heaviest 25 berry weight recorded on vines that received the RDN via three forms, T_5 (55.1 & 57.8 g) and T_6 (56.0 & 58.2 g), respectively, whereas, the lightest 25 berry weight was found on vines that fertilized by 100% mineral-N (50.6 & 53.3 g), respectively. Hence the increment percentage of berry weight due such treatments over check treatments T_7 was (8.89 & 8.44%) and (10.67 & 9.19%), respectively.

Table 2. Effect of bio-fertilization on some vegetative growth aspects of Flame Seedless grapevines during 2015 and 2016 seasons.

Treatments	Shoot length (cm)		No. leaves/shoots		Leaf area cm^2	
	2015	2016	2015	2016	2015	2016
1- 75% Mn + 25% bio. Y (T_1)	86.9	93.2	21.2	21.9	161.4	170.1
2- 75% Mn + 25% bio. B (T_2)	86.8	92.6	21.3	22.1	163.2	172.5
3- 50% Mn + 50% bio. Y (T_3)	85.0	90.8	21.5	22.6	164.3	172.8
4- 50% Mn + 50% bio. B (T_4)	84.7	93.4	21.8	22.5	167.6	173.0
5- 25% Mn + 50% bio. Y + 25% bio. B (T_5)	84.8	92.1	22.1	23.2	169.4	177.5
6- 25% Mn + 25% bio. Y + 50% bio. B (T_6)	86.2	91.3	22.4	23.3	171.5	179.6
7- 100% Mn (control) (T_7)	85.8	91.4	20.6	21.4	154.6	163.5
LSD 5%	**N.S.**	**N.S.**	**0.7**	**0.9**	**6.41**	**9.73**

Table 3. Effect of bio-fertilization on percentage of N, P & K in leaves of Flame Seedless grapevines during 2015 and 2016 seasons.

Treatments	N %		P %		K %	
	2015	2016	2015	2016	2015	2016
T_1	1.42	1.50	0.263	0.298	0.81	0.89
T_2	1.43	1.49	0.245	0.276	0.86	0.93
T_3	1.43	1.51	0.274	0.312	0.91	1.06
T_4	1.45	1.53	0.260	0.303	0.80	0.88
T_5	1.45	1.53	0.280	0.321	0.92	1.10
T_6	1.47	1.55	0.268	0.295	0.94	1.10
T_7	1.34	1.41	0.212	0.241	0.73	0.76
LSD 5%	**0.05**	**0.06**	**0.016**	**0.019**	**0.06**	**0.08**

Table 4. Effect of bio-fertilization on yield and some cluster traits of Flame Seedless grapevines during 2015 and 2016 seasons.

Treatments	Cluster weight (g)		Clusters number		Yield/vine (kg)		Compactness coefficient	
	2015	2016	2015	2016	2015	2016	2015	2016
T_1	335.8	364.6	27.6	31.8	9.27	11.58	6.65	6.60
T_2	338.7	366.5	27.1	30.9	9.18	11.32	6.51	6.52
T_3	340.1	360.5	27.8	33.7	9.45	12.15	6.43	6.29
T_4	344.1	373.6	28.3	33.3	9.74	12.44	6.40	6.60
T_5	350.4	383.2	28.1	33.2	9.85	12.72	6.23	6.12
T_6	357.8	390.6	28.3	34.3	10.13	13.40	6.11	6.18
T_7	289.8	315.6	27.5	28.7	7.97	9.06	6.41	6.36
LSD 5%	**23.10**	**18.75**	**N.S.**	**0.76**	**0.65**	**0.88**	**N.S.**	**N.S.**

Table 5. Effect of bio-fertilization on berry weight and chemical properties of berry of Flame Seedless grapes during 2015 and 2016 seasons.

Treatments	25 berry weight (g)		TSS %		Reducing sugar %		Anthocyanin (mg/g)		Acidity %	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
T_1	53.8	56.6	17.40	18.25	12.62	13.28	1.93	2.01	0.593	0.555
T_2	54.1	56.4	17.50	18.40	12.90	13.32	1.93	2.02	0.585	0.550
T_3	53.8	56.9	17.70	18.50	12.82	13.55	1.97	2.08	0.580	0.545
T_4	54.7	58.1	18.10	18.60	13.25	13.47	1.99	2.07	0.572	0.538
T_5	55.1	57.8	18.65	19.25	13.60	13.91	2.05	2.13	0.561	0.527
T_6	56.0	58.2	18.90	19.60	13.60	13.82	2.07	2.16	0.550	0.520
T_7	50.6	53.3	16.53	17.32	11.93	12.42	1.83	1.91	0.632	0.606
LSD 5%	**2.11**	**2.81**	**0.67**	**0.72**	**0.62**	**0.78**	**0.07**	**0.08**	**0.028**	**0.035**

The increase in berry weight and size is an important target as grapes quality due to the increase in berry weight and size result in an increase in pack able yield. Also, all fertilization applications significantly improved the chemical constituents of berry juice in term of increased the total soluble solids, reducing sugars and anthocyanin contents and decreased the total acidity compared to use mineral-N only. Furthermore, vines fertilized via three forms (T_5 & T_6) recorded the maximum values of these traits compared to other fertilization treatments. The highest total soluble solids, reducing sugars and anthocyanin contents obtained on vines fertilized with (T_6) fertilization, TSS (18.90 & 19.60%), anthocyanin (2.07 & 2.16 mg/g) during the two studied seasons, respectively. Contrary, the least values of these traits were recorded on vines that fertilization by control (T_7) (16.53 & 17.32%) and (1.83 & 1.91 mg/g), respectively. Hence, the increment percentage of these attributes due to using fertilization via the three forms (T_6) over the check treatment, (T_7) attained (14.34 & 13.66%) and (13.11 & 13.08%), respectively. Also, such amending induce decrement percentage in total acidity attained (12.97 & 14.19%), respectively.

On the account of the present results it could be concluded that replacing 75% of nitrogen requirements of vine by bio-form improved the growth and nutritional status as well as, yield, cluster attributes and berry quality of grapevines.

Discussion:

The role of bio-fertilization on facilitating the fixation of atmospheric N as well as activating the availability uptake and translocation of most nutrients, that accelerating carbohydrate and protein synthesis and movement which aid to encouraging cell division and the development of meristematic tissues. Moreover, it enhancing the resistance of plants to root diseases and controlling vegetative growth of trees, then, improving its productivity (Gaur *et al.*, 1980 and Suba Rao, 1984). In addition, the yeast and bio-power have high content of nutrients, amino acids, vitamins and cytokinins. The effect of bio-fertilizer on activating the synthesis of total carbohydrates and proteins which enhances cell division and enlargement leading to improving the vine growth and nutritional status and maintaining a good balance between total carbohydrates and nitrogen in favor improving bud burst and fertility coefficient that lead to an increase of cluster number per vine, hence the yield was increased and hastened the maturation and improved berry quality. These results agree with those of Abdel-Hamid (2002), Abdel-Hady (2003), El-Shenawy and Fayed (2005), Abbas *et al*. (2006), El-Salhy *et al*. (2006), Mostafa (2008), Abdel-Monem *et al*. (2008), Hegab *et al*. (2010), El-Sabagh *et al*. (2011), El-Salhy *et al*. (2011), Masoud (2012) and El-Salhy *et al*. (2013). concluded that application N via mineral and bio form was improved the growth aspects, yield and berry quality.

Conclusion:

So it could be concluded that replacing 50-75% of nitrogen requirements for grapevines by either organic manure or bio-fertilization, are sufficient to improve nutritional status of grapevines and gave a suitable yield with high cluster and berry traits. In addition minimized the production cost and the environmental Pollution which could be occurred by excess of chemical fertilizers.

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Assiut J. Agric. Sci., (48) No. (1-1) 2017 (191-201) *ISSN: 1110-0486*
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تأثير رش الخميرة والمنشط الحيوي علي نمو وإثمار كروم العنب الفليم عديم البذور

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الملخص:

أجريت هذه الدراسة خلال موسمي ٢٠١٥ ، ٢٠١٦ علي شجيرات العنب الفليم عديم البذور المنزرعة بمزرعة آفاق بمنطقة بلاط بالوادي الجديد. بهدف دراسة تأثير رش الخميرة والمنشط الحيوي علي النمو الخضري وحالة العناصر الغذائية والمحصول وخصائص العناقيد والحبات.

وقد أظهرت النتائج الأتي:

– أدي استخدام التسميد في الصورة الثنائية (معدني + حيوي) أو الصورة الثلاثية (معدني + خميرة + المنشط الحيوي) إلي زيادة مؤكدة في عدد الأوراق لكل فرع ومساحة الأوراق ومحتوي الأوراق من عناصر النيتروجين والفوسفور والبوتاسيوم بينما لم تظهر فروق جوهرية في طول الأفرع مقارنة بإستخدام التسميد في الصورة المعدنية فقط.

– سبب إستخدام التسميد في الصورة المركبة تحسين صفات العنقود والثمار مقارنة بالتسميد المعدني فقط.

– أظهرت النتائج تفوق استخدام المنشط الحيوي مقارنة بإستخدام الخميرة.

من نتائج هذه الدراسة يمكن التوصية بأهمية استخدام خليط الأسمدة في الصورة الثنائية (٥٠% معدني + ٥٠% حيوي) أو الثلاثية (٢٥% معدني + ٥٠ أو ٢٥% منشط + ٥٠ أو ٢٥% خميرة) وذلك لتحسين النمو الخضري والحالة الغذائية لشجيرات العنب مع إنتاج محصول عال ذو خصائص ثمرية جيدة. فضلاً عن تقليل تكاليف التسميد والتلوث البيئي الناشئ عن الأسمدة المعدنية.