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Effect of Some Nutrient, Yeast Spraying and Girdling on Yield and Berry Quality of Flame Seedless Grapes

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Abstract

To investigate the effect of sucrose, yeast and landamine$_{Zn}$ spraying and girdling on yield and berry quality of Flame Seedless grapes. Twenty four uniformly vine was selected, as eight treatments with three replications one vine each. The study was carried out during 2019 and 2020 seasons. The experiment set up in a randomized complete block design, where, the study included The obtained results could be summarized as follows; Yield/vine and cluster weight were significantly increased due to spray either sucrose, yeast or landamine$_{Zn}$ as well as arm girdling compared to untreated ones (control). Spraying 4 g/L landamine$_{Zn}$ was very effective in increasing yield and cluster weight than other treatments. Moreover, all studied treatments significantly improved the berry quality in terms of increasing berry weight, total soluble solids and anthocyanin in skin of berries and decreasing berry firmness and total acidity compared to untreated ones. The greatest results were obtained due to spraying landamine$_{Zn}$ at 2 or 4 cm^3/L where gave a high yield of good berry quality. No significant differences were obtained due to spray landamine$_{Zn}$ at 2 or 4 cm^3/L, as well as yeast, sucrose or girdling. It could be concluded that spraying 2 to 4 cm^3/L landamine$_{Zn}$ to get high yield with good cluster and berry quality of Flame Seedless grapes.

Key words: Yeast, sucrose, nutrients, grapevines, girdling, quality.

Introduction

Grapes are one of the most important fruit crops for local consumption and export. The total world area of grapes reached 7.4 million ha with a total production of 77.8 million ton fruits (57% of wine grape , 36% of table grape , 7% of dried grape) in 2018 (OIV, 2019). In Egypt grapes are an economically important crop and cultivated area was 196905 feddan that produced about 1594781 ton of fruits a country (FAO, 2016). One of the goals of researcher is to increase the production of fruits to satisfy the requirements for local consumptions and export to foreign markets. The increase could be achieved by importing cultural practices (El-Salhy *et al*., 2006). Fertilization is an important and limiting factor for growth and productivity of grapevines. Among these nutrients, potassium activates enzymes that water and nutrients transport, root growth, drought and salinity resistance, biosynthesis and translocation of sugars and regulating the opening and closing of stomata (Marschner, 1995 and Dhillon *et al*., 1999). Phosphorus plays an important role to increase the vital functions in plants, particularly for the formation of nucleic acids biosynthesis and translocation of carbohydrate and protein synthesis (Havlin *et al*., 2005). Zinc is involved in production and function of many enzymes as well as many growth hormones (Salisbury and Ross, 1992). In addition, yeast has high content of mineral particularly, N, P and K, proteins, vitamin B and natural hormone (Ferguson *et al*., 1987). Furthermore, sucrose improved fruit color development due to increase synthesis and accumulation of anthocyanin, these allowing earlier harvests and improving table grape quality (Gibson, 2005 and Olivares *et al*., 2017). Moreover, girdling and scoring will be effective techniques to improve berry quality and advance maturity in a wide variety of fruit trees (Hossain and Boyce, 2009). The beneficial effects of sucrose and yeast as well as potassium, phosphorus and zinc spraying, in addition girdling done on increasing yield and improving berry quality were emphasized by Shoaieb (2002), Poni *et al*. (2003), Saleh *et al*. (2007), Er *et al*. (2009), Hossain and Boyce (2009), Chang *et al*. (2015), Noori *et al*. (2018), Gouda *et al*., 2019 and Ahmed-Mona (2020). Therefore, the aim of this study was to investigate the benefits of sucrose, yeast and landamine$_{Zn}$ spraying and girdling done on fruiting of Flame Seedless grapevines.

Materials and Methods

This investigation was executed through two successive seasons of 2019 and 2020 on Flame Seedless grapevines were seven years old, budded on freedom vine rootstock and grown in sandy soil under drip irrigation system, 50 cm between drips, in private Orchard at Al-Marashda, Qena Governorate. Vines were trained by cane method using Parron system at 2 x 3 m apart, number of clusters fixed to 25 bunch/vine. Twenty four vines at almost uniform in their vigor were chosen and divided into eight different treatments including the control. The eight different treatments were as follows:

1- Control (spraying water).
2- Spraying with 2 g/L sucrose.
3- Spraying with 4 g/L sucrose.
4- Spraying with 2 g/L yeast.
5- Spraying with 4 g/L yeast.
6- Spraying with 2 cm^3/L Landamine$_{Zn}$.
7- Spraying with 4 cm^3/L Landamine$_{Zn}$.
8- Girdling arms after berry softening.

Landamine$_{Zn}$ as a nutritious solution that contains 24% potassium (K_2O), 21% phosphorus (P_2O_5) and 1.6% zinc (in chelated form). All spraying treatments were carried out after fruit set, while girdling after berry softening. Girdling was carried out by removing a narrow ring of the bark (2 mm) entirely around the arms. The experiment was arranged in a randomized complete block design (RCBD) with three replications, one vine per each. The following parameters were determined to evaluate the effects of different treatments on yield and berry quality during the two studied seasons.

Yield components

At the last week of May, the yield of each vine was recorded in terms of weight (in kg).

Cluster and berry properties

At harvesting, three clusters per each vine were taken at random for determinations the cluster and berry traits such as cluster weight and cluster compactness coefficient. Berry quality such as berry weight, total soluble solids %, reducing sugars % and total acidity % (expressed as tartaric acid per 100 ml/juice) berry chemical properties were determined according to A.O.A.C. (1995). In addition, Berry firmness (g/cm2), was recorded by using a texture analyzer instrument (Fruit Hardness Tester, No. 510-1), as well as the anthocyanin content was determined from the standard calibration curve of cyaniding-3-glucoside as pointed out by Markham (1982). The statistical analysis of the present tabulated data was carried out according to Snedecor and Chocran (1980). Averages were compared using the new L.S.D. values at 5% level.

Results

1- Yield and cluster traits:

Data presented in Table (1) show the effect of sucrose, yeast and landamine$_{Zn}$ spraying as well as girdling on yield and cluster traits of Flame Seedless grapevines during 2019 and 2020 seasons. It is obvious that the results took the similar trend during the two studied seasons. As an overview, results declared that use either of landamine$_{Zn}$ or yeast gave the heaviest yield/vine and cluster, followed by use of sucrose spraying, then girdling. This is logical, as the spraying treatments were done at the beginning of berry growth stage, while the girdling takes place after berry softening. The obtained yield/vine values were (10.59, 10.81, 10.65, 10.98, 11.33, 11.80, 10.58 & 9.79 kg/vine) and cluster weight (423.7, 432.5, 425.8, 439.2, 453.3, 472.0, 423.3 & 391.5 g av. two studied seasons) due to spray, 2 g/L sucrose, 4 g/L sucrose, 2 g/L yeast, 4 g/L yeast, 2 cm^3/L landamine$_{Zn}$, 4 cm^3/L landamine$_{Zn}$, girdling and untreated one (control), respectively. Hence, the corresponding increment percentage of yield/vine over control was attained (8.17, 10.42, 8.78, 12.16, 15.73, 20.53 & 8.07%, respectively). Moreover, the results showed that there were no significant differences between the two concentrations used as well as yeast or sucrose spraying. Therefore, from an economic point of view, it could be use yeast or landamine$_{Zn}$ at low concentration must be sprayed to produce a high yield/vine. In general look at the results, it could be seen that all treatments haven't significant effects on the number of berries of the cluster, as well as cluster length compared to untreated one (control). Hence, the treatments failed to show clear effects on cluster compactness coefficient compared to untreated one (control).

2- Berry quality:

Data of berry quality as affected by different treatments are presented in Tables (2 & 3). Data indicated that all treatments significantly increased the berry weight compared to untreated ones (control). Spraying 4 cm^3/L landamine$_{Zn}$ gave the heaviest berries, followed by spraying with 4 g/L yeast as compared to the control and other treatments. The obtained 25 berry weight was (60.3, 61.8, 62.5, 64.3, 62.0, 66.3, 62.7 & 57.0 g av. of the two studied seasons) due to spray sucrose at 2 g/L & 4 g/L, yeast at 2 g/L & 4 g/L, landamine$_{Zn}$ at 2 cm^3/L & 4 cm^3/L, girdling and control, respectively. Hence the corresponding increment percentage due to use studied treatments over untreated one (control) attained (5.79, 8.42, 9.65, 12.81, 8.77, 16.32 & 10.0%, respectively). Also, as the average of two studies seasons, data indicated that all treatments significantly decreased berry firmness compared to untreated one. The firmness of berries could be arranged in descending order as follows (13.73, 13.44, 13.41, 12.74, 12.54, 11.63 and 11.36 as an av. of the two studied seasons, respectively) when vines were treated with 2cm^3/L landamine$_{Zn}$, 4cm^3/L landamine$_{Zn}$, 2gm/L sucrose, 4gm/L sucrose, girdling & 2gm/L yeast and the lowest at vine was treated with 4gm/L yeast as compared with untreated

vine (14.70 g/cm^3). Treatment with 2cm^3/L landamine$_{Zn}$ proved to be more beneficial than the other applications. Hence, the decrement percentage of berry firmness attained (20.88, 22.72, 6.50 & 8.59% as av.

Table 1. Effect of sucrose, yeast and landamine$_{Zn}$ spraying and girdling on yield and cluster traits of Flame Seedless grapes in 2019 and 2020 seasons.

Treat-ments	Yield/vine (kg)			Cluster weight			Cluster compactness		
	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean
T_1	9.33	10.25	9.79	373.0	410.0	391.5	7.27	6.92	7.09
T_2	10.29	10.89	10.59	411.7	435.7	423.7	7.56	7.40	7.48
T_3	10.33	11.29	10.81	413.3	451.7	432.5	7.30	6.79	7.04
T_4	10.46	10.83	10.65	418.3	433.3	425.8	7.43	7.19	7.31
T_5	10.75	11.21	10.98	430.0	448.3	439.2	6.79	7.14	6.96
T_6	10.63	12.04	11.33	425.0	481.7	453.3	6.93	7.12	7.03
T_7	11.29	12.31	11.80	451.7	492.3	472.0	7.01	7.53	7.27
T_8	10.25	10.92	10.58	410.0	436.7	423.3	6.73	7.16	6.95
New L.S.D 5%	0.53	0.48	0.49	20.19	18.46	19.17	NS	NS	N.S.

T_1: Control, T_2: 2 g/L sucrose, T_3: 4 g/L sucrose, T_4: 2 g/L yeast, T_5: 4 g/L yeast, T_6: 2 cm^3/L landamine$_{Zn}$, T_7: 4 cm^3/L landamine$_{Zn}$, T8: Girdling

of the two studied seasons) due to spray with 2 g/L yeast, 4 g/L yeast, 2 cm^3/L landamine$_{Zn}$ or 4 cm^3/L landamine$_{Zn}$ compared to unsprayed ones (control), respectively. Moreover, the results showed that there were no significant differences between the two concentrations used of sucrose, yeast or landamine$_{Zn}$ as well as sucrose or girdling. In a general view, the results showed the importance of using landamine$_{Zn}$ pre-ripening of berries. This treatment leads to production of good appearance clusters with high hardiness, which increases the marketing period and increases the price. Moreover, previous data cleared that all studied treatments significantly increased total soluble solids, reducing sugar and anthocyanin in berry skin and significantly decreased the total acidity in berry juice compared to untreated one (control). So, it could be arranged the obtained TSS values in descending order as follow (18.00, 17.75, 17.37, 17.00, 16.60, 16.33, 15.95 1& 14.75%, respectively as an av. of the two studied seasons) due to use 4 cm^3/L landamine$_{Zn}$, 4 g/L yeast, 2 cm^3/L landamine$_{Zn}$, 2 g/L yeast, 4 g/L sucrose, girdling, 2 g/L sucrose and untreated ones (control), respectively. Hence, the corresponding increment percentage of total soluble solids TSS was attained (22.44, 20.34, 17.76, 15.25, 12.54, 10.71& 8.13, respectively) for using treatments compared to untreated ones (control), respectively. Moreover, the recorded anthocyanin value could be arranged in descending order as follows (30.31, 29.00, 28.80, 26.70, 24.97, 24.35, 23.15 & 18.31%, respectively) due to use 4 cm^3/L landamine$_{Zn}$, 4 g/L yeast, 2 cm^3/L landamine$_{Zn}$, 2 g/L yeast, girdling, 4 g/L sucrose, 2 g/L sucrose and untreated ones (control), respectively. Hence, the corresponding increment percentage attained (64.64, 57.52, 56.44, 45.03, 35.63, 32.27 & 25.75%, respectively). Additionally, there are no significant differences between the two used concentration of any used materials, as well as spray with landamine$_{Zn}$ or yeast, also, sucrose spraying, or girdling done. Therefore, from economic view, it could be recommended to spray with 2 cm^3/L landamine$_{Zn}$ or 2 g/L yeast due to produce early grape berries with good quality.

Discussion

In a clearly sense, these treatments significantly increased all studied traits. In addition, cluster compactness coefficients were not affected. While, these treatments induce the significant decrease of juice acidity and berry firmness compared to untreated ones (control). In general, 4cm^3

landamine$_{Zn}$, 4g yeast and 2cm^{3}landamine$_{Zn}$ gave the highest increasing in this respect compared to the control and other treatments. These results emphasized the importance of landamine$_{Zn}$ spraying those contents of potassium, phosphorus and zinc. These nutrients minerals had positive effect on the growth and nutritional status of vines, thus

Table 2. Effect of sucrose, yeast and landamineZn spraying and girdling on berries traits of Flame Seedless grapes in 2019 and 2020 seasons.

Treat-ments	Weight 25 berries			Berries firmness(g/cm2)			T.S.S%		
	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean
T1	56.3	57.7	57.0	14.61	14.79	14.70	14.83	14.67	14.75
T2	59.0	61.7	60.3	13.42	13.39	13.41	15.80	16.10	15.95
T3	60.3	63.3	61.8	12.65	12.83	12.74	16.40	16.80	16.60
T4	62.7	62.3	62.5	11.38	11.88	11.63	17.30	16.70	17.00
T5	64.0	64.7	64.3	10.91	11.81	11.36	18.20	17.30	17.75
T6	61.3	62.7	62.0	13.61	13.85	13.73	17.40	17.33	17.37
T7	65.0	67.7	66.3	13.46	13.42	13.44	18.23	18.00	18.12
T8	61.0	64.3	62.7	11.97	13.11	12.54	16.43	16.22	16.33
New L.S.D 5%	3.19	2.92	3.02	0.52	0.59	0.53	0.109	9.70	0.96

T1: Control, T2: 2 g/L sucrose, T3: 4 g/L sucrose, T4: 2 g/L yeast, T5: 4 g/L yeast, T6: 2 cm3/L landamineZn, T7: 4 cm3/L landamineZn, T8: Girdling

increasing the yield and improving the cluster traits with good berry quality. Higher potassium supply increased TSS content and reduced total acidity of berries. Adequate potassium nutrition helps to increase the contents of berries coloring (Martin *et al*., 2004 and Saleh *et al*., 2007). Phosphorus is a major element required by plants for increasing the vital functions and cellular membranes, enzymes and energy (Havlin *et al*., 2005). Furthermore, zinc plays a vital part in numerous biochemical responses within the plant. It regulates the activity of several enzymes which lead to stimulation of carbohydrates, proteins and the DNA formation (Hassan *et al*., 2010). Zn treatments enhanced the accumulation of total soluble solids, anthocyanins in berry skin and decreasing the titratable acidity (Chang *et al*., 2015). The promotive effects of potassium, phosphorus and zinc using on fruiting of grapevines were emphasized by Shoaieb (2002), Poni *et al*. (2003), Al-Mashileh and Al-Rayes (2004), Saleh *et al*. (2007), Er *et al*. (2009), Noori *et al*. (2018), El-Badawy (2019), Abou-Zaid and Shaaban (2019) and Ahmed-Mona (2020). They concluded that using different forms of potassium, phosphorus or zinc fertilization had a positive effect on yield and berry quality different grape cultivars. In addition, yeast has high content of mineral particularly, N, P and K, proteins, vitamin B and natural hormone, i.e., cytokinin and IAA. The improving effect of yeast application was attributed to auxins, hormones, vitamins, chelating agents and enzyme produced, which have stimulatory effects on cell division and enlargement, nutrient uptake, protein synthesis and improve net photosynthesis. These effects induced an improving of hormones and accumulation of carbohydrates consequently raising sugars and anthocyanin contents in berry induce advancing of the berry ripening (Ferguson *et al*., 1987 and El-Salhy *et al*., 2006). The results dealing with the effect of yeast spraying on grapevines fruiting are in harmony with those of Hassan (2002), Omran and Abdel-Latif (2003),Gasar *et al*. (2006), El-Salhy *et al*. (2006), Fawzi *et al*. (2014), El-Halaby *et al*. (2015), Al-Hawezy and Ibrahim (2018) and Radwan *et al*. (2019). They concluded that spraying yeast significantly increased the yield/vine, as well as significantly improved of berry quality in terms of increasing the berry size, TSS, reducing sugars and anthocyanin contents and decreasing the total acidity then induce advance the berry ripening. Moreover,

sucrose improved fruit color development by increasing synthesis and accumulation of anthocyanins, thus allowing earlier harvests and improving table grape quality (Gibson, 2005 and Olivares *et al*., 2017). Moreover, girdling and scoring will be effective techniques to improve berry quality and advance maturity in a wide variety of fruit trees. These positive effects are due to accumulate carbohydrates in the parts above

Table 3. Effect of sucrose, yeast and landamineZn spraying and girdling on reducing sugars, acidity and anthocyanin of Flame Seedless grapes in 2019 and 2020 seasons.

Treat-ments	Reducing sugars %			Acidity %			Anthocyanin%		
	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean
T1	11.01	11.87	11.44	0.670	0.740	0.705	18.32	18.50	18.41
T2	12.42	12.45	12.44	0.555	0.635	0.595	23.00	23.30	23.15
T3	13.07	13.33	13.20	0.545	0.560	0.553	25.10	23.59	24.35
T4	12.34	12.46	12.40	0.580	0.640	0.610	27.60	25.80	26.70
T5	14.50	13.57	14.04	0.550	0.615	0.583	30.89	27.10	29.00
T6	13.90	14.49	14.20	0.550	0.560	0.555	30.77	26.83	28.80
T7	15.22	14.66	14.94	0.510	0.525	0.518	32.40	28.21	30.31
T8	13.08	14.04	13.56	0.520	0.545	0.533	25.76	24.17	24.97
New L.S.D 5%	0.96	1.08	0.95	0.059	0.048	0.055	2.13	1.91	1.89

T1: Control, T2: 2 g/L sucrose, T3: 4 g/L sucrose, T4: 2 g/L yeast, T5: 4 g/L yeast, T6: 2 cm3/L landamineZn, T7: 4 cm3/L landamineZn, T8: Girdling

the girdle and results enhance and hasten to ripen (Takayoshi and Katsutashi, 2006 and Hossain and Boyce, 2009). The result of girdling on improving berry quality of grapevines was supported by many authors such as Fawzi and Eman (2003), Omar and Girgis (2005), Abd El-Wahab (2006), Hossain and Boyce (2009), Abu-Zahra (2010), Soltekin et al. (2015) and El-Kenway (2018).

Conclusions: On the light of the current results, it could be concluded that spraying 2-4 cm3/L landamineZn or 2-4 g/L yeast to produce high yield with good cluster and berry quality for local and export markets. In addition, to avoid damages arising from errors of girdling.

Conflicts of Interest: The authors declare that they have no competing interests.

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تأثير رش بعض العناصر والخميرة والتحليق علي محصول وجودة حبات العنب الفليم عديم البذور

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أجريت هذه الدراسة خلال موسمين متتاليين هما 2019، 2020 علي كروم العنب الفليم اللابذري المطعومة علي أصل Freedom والمنزرع بمزرعة خاصة بمنطقة المراشدة – محافظة قنا.
يهدف البحث إلي دراسة تأثير الرش بمحلول السكروز أو الخميرة أو اللاندمين زنك (مركب مغذي يحتوي علي 24% بوتاسيوم و21% فوسفور و1.6% زنك مخلبي) بالإضافة إلي تحليق الأذرع حيث تم الرش بعد عقد الحبات بينما تم التحليق في بداية ليونة الحبات. وقد تم تصميم التجربة بنظام القطاعات كاملة العشوائية تحتوي علي ثماني معاملات وكل معاملة 3 مكررات وكل مكررة كرمة واحدة.
ويمكن تلخيص النتائج المتحصل عليها كالتالي:

- أظهرت جميع معاملات الرش أو التحليق زيادة معنوية في وزن المحصول/كرمة وكذلك وزن العناقيد بينما لم تؤثر معنوياً علي معامل تزاحم الحبات بالعنقود مقارنة بعدم الرش أو التحليق (المقارنة).
- أدت المعاملات إلي تحسين معنوي في صفات الحبات حيث سببت زيادة معنوية في وزن الحبات ومحتواها من المواد الصلبة الكلية والسكريات وصبغة الأنثوسيانين مع نقص معنوي في محتوى الثمار من الحموضة الكلية وكذلك صلابتها مقارنة بمعاملة المقارنة.
- سجلت أفضل النتائج نتيجة الرش باللاندمين زنك حيث أعطت أعلي محصول وأحسن صفات ثمريه مقارنة ببعض المعاملات.
- لم تسجل فروق معنوية بين رش اللاندمين زنك سواء 2 أو 4 سم^3/لتر. كذلك بين رش السكروز أو الخميرة أو التحليق.

من نتائج هذه الدراسة يمكن التوصية بأهمية الرش باللاندمين زنك بتركيز من 2-4 سم^3/لتر ورش الخميرة بمعدل 2-4 جم/لتر وذلك لإنتاج محصول عال ذو خصائص حبات جيدة للعنب الفليم عدم البذور تتفق مع السوق المحلي والمنافسة للتصدير.