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(Original Article)

Effect of Spraying Nano- Potassium and lemon Grass Oil on Yield and Quality of Flame Seedless Grapevines

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Abstract

This study was carried out during 2022 and 2023 seasons to examine the effect of spraying nano- potassium and/ or lemon grass oil, each at 0.05 to 0.2% on yield and quality of berries of Flame seedless grapevines. There was a remarkable and gradual promotion on yield expressed in weight (kg.) and number of clusters per vine as well as weight, length and width of cluster due to increasing concentrations from 0.05 to 0.2% of each nano potassium and lemon grass oil in combination rather than untreated vines.

Subjecting the vines to nano- potassium and/ or lemon grass oil had beneficial effect on improving quality of berries in terms of increasing berry colorations% in the cluster, berry weight and dimensions, TSS%, total sugars, % and reducing percentage of titratable acidity over the check treatment. The promotion was related to the increase in the concentrations of non- potassium and lemon grass oil.

Therefore, it is necessary to use a mixture of nano- potassium and lemon grass oil each at 0.2% three times (growth start, just after berry setting and one month later) for improving yield quantitatively and qualitatively of Flame seedless grapevines grown under Middle Egypt conditions.

Keywords: *Flame seedless grapevines, Lemon grass oil, Nano- potassium, Quality, Yield.*

Introduction

Grapes are ranked first in cultivation and production worldwide. In Egypt, it is the third main fruit after citrus and mango. Flame seedless grapevines is very important grape cultivar grown in Egypt. It is one of the most delicious, refreshing and nourshing subtropical the fruits. The berry is a good source of reducing sugars, vitamins, some minerals and organic acids. Berry consumed in fresh forms as a table fruit and in the processed form wine, raisin and fresh juice. Flame seedless grapes is gaining more popularity, both as raisin making and table purpose because of its high total soluble solids and desired shape and thin skin (FAO, 2018).

Potassium is a mobile element in plants and deficiency symptoms usually appear first on mature leaves. Potassium is an activator of enzymes that are essential for photosynthesis and respiration as well as enzymes that produce starch and proteins (Bhandal and Malik, 1988). It is also involved in the osmotic potential of cells as well as the turger of the guard cells that open and close stomata as well as a reduction in the

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growth (Salisbury and Ross, 1992 & Smolarz and Marick, 1997) also showed that a lack of potassium resulted in a decrease in yield and fruit weight (Conradie et al., 1989).

Nano fertilizers play an important role in physiological and biochemical processes, helping to enhance metabolic processes and stimulate meristematic activities, leading to increased apical growth, photosynthesis and fruiting. Nano- fertilizer is crucial for increasing growth aspects, flowering so, increasing productivity, product quality and shelf life of fruits (Blois *et al.,* 2018).

Plant extracts are considered as a source of some antioxidants and nutrients supplying the plants with their requirements for some antioxidants and nutrients. Their antioxidative properties appeared for preventing reactive oxygen species (Kirtikar and Basu, 1984; Botelho, *et al.,* 2007 and Bhanu *et al.,* 2013).

Lemon grass (*cymbopgen, citratus*) is an aromatic plant belonging to the gramineaeu family (Akhila, 2010). Essential oils are natural products obtained from plants. It contains mainly citral (Schaneberg and Khan, 2002) and 1.0 to 2.0 % essential oil (Carison *et al.,* 2001 and Mighant, *et al.*, 2010). The demand for lemon grass is for its high citral content (Tajidin *et al.,* 2012). Sweet basil, *Cimum basilicum* L. belongs to the family Iamiacae. It is a popular culinary herb and source of vitamins, K, Mg, Ca, Fe and Oils (Nacar and Tansi, 2012).

The target of this study is to improve yield and berry quality of Flame seedless grapevines by using application of nano- potassium and lemon grass oil.

Materials and Methods

This study was carried out during 2022 and 2023 seasons on 60 uniform vines in vigour -8 years old Flame seedless grapevines located in a private vineyard located at Darwa village, Malalwy district, Minia Governorate, Egypt. The selected vines (60 vines) are planted at 2.0 x 3.0 meters a part. Gable supporting system as followed. The selected vines were short pruned (Spur pruning) during the last week of December during both seasons, leaving 72 eyes/vine (on the basis of 20 fruiting spurs x three eyes plus 6 replacement spurs x two eyes). The texture of tested soil was clay soil. Surface irrigation system was followed using Nile water. The vines received the common horticultural practices that already applied in the vineyard.

Soil analysis was done according to Wilde *et al.,* (1985) and the obtained data are shown in Table (1).

The present experiment included the following 10 treatments from nano-potassium and/or lemon grass oil.

1-Control (vines sprayed with tap water).

2-Spraying nano potassium at 0.05%.

3-Spraying nano potassium at 0.1%

4-Spraying nano potassium at 0.2%

5-Spraying lemon grass oil at 0.05%

6-Spraying lemon grass oil at 0.1%

7-Spraying lemon grass oil at 0.2%

8-Spraying both at low concentration.

9-Spraying both at medium concentration.

10-Spraying both at high concentration.

Each treatment was replicated three times, two vines per each. Nano potassium and Lemon grass oil were sprayed three times at growth start (1st week of March), just after berry setting (1st week of April) and at one month later (1st week of May). Triton B as a wetting agent was added to all solutions at 0.05 % (0.5 ml/ L.). Spraying was done till run off.

Randomized Complete Block Design (RCBD) was followed in which the experiment included ten treatments, and each treatment was replicated three times, two vines per each.

During 2022 and 2023 seasons, the following parameters were recorded:

-The yield per vine (kg.), the total number of clusters per vine, as well as weight of clusters (gm.), length and width of clusters (cm.)

-The percentage of berry coloration in the cluster.

-The physical and chemical characteristics of the berries (berry quality), namely berry weight (gm.), length and equatorial (cm.), TSS%, reducing sugars (Lane and Eynon, 1965), total acidity % (as tartaric acid/100 ml/ juice) (A.O.A.C., 2000), and TSS/ acid ratio.

All obtained data were tabulated and statistically analyzed according to (Mead *et al.,* 1993) and treatment means were compared using new L.S.D. at 5%.

Table 1. Some physical and chemical properties of the soil of the experimental site

Constituents	Values	Constituents	Values
Sand %	6.8	**$CaCO_3$ (%)**	1.22
Silt %	14.4	**Total N (%)**	0.09
Clay %	78.8	**Av. P (Olsen method (ppm)**	6.11
Texture	Clay	**Av. K (ammonium acetate ppm)**	7.18
pH (1:2.5 extract)	7.98	**Fe (ppm)**	62.8
Ece (ds/ m^{-1})	1.08	**Zn (ppm)**	8.11
Organic matter (%)	2.06	**Mn (ppm)**	4.06

Results and Discussion

1. Yield and cluster aspects

Data in Table (2) noticeably reveal that subjecting Flame seedless grapevines with nano-potassium three times at 0.05 to 0.2% and/ or lemon grass oil at 0.05 to 0.2% had a significant on yield characteristics as accompanied with improving the yield expressed in weight (kg.) and number of clusters per vine as well as weight, length and width of cluster over the control treatment. The promotion was significantly in proportional to the increase in concentrations of nano- potassium and lemongrass oil. Increasing concentrations of nano- potassium and lemon grass oil from 0.05 to 0.2% failed to show significant promotion on the yield and cluster aspects. Yield per vine and

cluster aspects were significantly improved in response to using nano- potassium than using lemon grass oil. Combined application of nano- potassium and lemon grass oil significantly was superior than using each material alone in improving the yield and cluster aspects. From an economical point of view, using nano- potassium and lemon grass oil, each at 0.1% gave the best results with regard to yield. In such promised treatment, yield per vine reached 13.05 and 17.94 kg. While in the untreated vines, it reached 10.44 and 10.80 kg. during both seasons, respectively. The percentage of yield obtained using the nano- potassium and lemon grass oil each at 0.1% over the control treatment reached 25.0 and 66.1 % during both seasons, respectively. These results were true during 2022 and 2023 seasons.

Table 2. Effect of single and combined application of spraying nano-potassium and Lemon grass oil on yield expressed in weight (kg.) and number of clusters per vine as well as weight and dimensions of cluster of Flame seedless grapevines during 2022 and 2023 seasons

Characters / Treatments	Clusters number / vine		Yield/ vine (kg.)		Cluster weight (gm.)		Cluster height (cm.)		Cluster diameter (cm.)	
	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023
T_1 – Control (water only)	29.0	30.0	10.44	10.80	360.0	360.0	20.5	21.0	11.6	11.0
T_2 – Nano potassium at 0.05%	28.0	35.0	10.92	13.83	390.0	395.0	23.5	24.0	13.2	13.5
T_3 – Nano potassium at 0.1 %	29.0	36.0	11.89	14.94	410.0	415.0	25.0	26.0	13.6	14.0
T_4 – Nano potassium at 0.2 %	29.0	37.0	12.18	15.73	420.0	425.0	26.0	26.8	14.0	14.2
T_5 – Lemon grass oil at 0.05%	29.0	31.5	10.63	11.66	366.5	370.0	22.0	22.6	12.1	12.5
T_6 – Lemon grass oil at 0.1 %	28.0	33.0	10.40	12.54	371.0	380.0	22.8	23.5	12.7	13.0
T_7 – Lemon grass oil at 0.2 %	29.0	34.0	11.02	13.26	380.0	390.0	23.4	24.0	13.0	13.4
T_8 – Both at low concentration	29.0	38.0	12.47	16.72	430.0	440.0	26.0	27.0	14.2	15.0
T_9 – Both at medium concentration	29.0	39.0	13.05	17.94	450.0	460.0	27.4	28.2	15.0	15.5
T_{10} – Both at high concentration	30.0	39.0	13.80	18.33	460.0	470.0	28.5	29.6	16.2	17.0
New L.S.D. at 5%	NS	1.1	0.5	0.9	8.2	8.5	0.7	0.8	0.5	0.6

2. Percentages of berries coloration in the cluster

Percentage of berries coloration was significantly improved, as shown in Table (3) in response to treating the vines with nano- potassium and/or lemon grass oil, each at 0.05 to 0.2%, relative to the control treatment. Using nano– potassium was significantly superior than using lemon grass oil in enhancing berry coloration%. Increasing concentrations of nano- potassium and lemon grass oil from 0.05 to 0.2% had no significant promotion on the berry coloration%. Combined application of nano-potassium and lemon grass oil significantly surpassed the application of each material alone in enhancing berry coloration %. The best percentage coloration of berries occurred when the vine was treated three times with a mixture of nano- potassium and lemon grass oil, each at 0.2% under such promised treatment. Berry coloration% reached 83.0 and 88.0%, while in the untreated vines reached 68.0 and 69.0% during both seasons, respectively. These results were true during both seasons.

Table 3. Effect of single and combined application of spraying nano-potassium and Lemon grass oil on some physical characteristics of the berries of Flame seedless grapevines during 2022 and 2023 seasons

Characters / Treatments	Berry coloration%		Berry weight (gm)		Berry length (cm)		Berry diameter (cm.)	
	2022	2023	2022	2023	2022	2023	2022	2023
T_1 – Control (water only)	68.0	69.0	3.15	3.20	2.11	2.13	1.80	1.82
T_2 – Nano potassium at 0.05%	73.8	75.0	3.60	3.65	2.25	2.30	1.90	1.94
T_3 – Nano potassium at 0.1 %	75.0	77.0	3.66	3.70	2.33	2.38	1.96	1.99
T_4 – Nano potassium at 0.2 %	76.8	77.6	3.75	3.80	2.40	2.44	1.99	2.02
T_5 – Lemon grass oil at 0.05%	70.1	71.5	3.25	3.30	2.15	2.18	1.85	1.91
T_6 – Lemon grass oil at 0.1 %	71.3	72.5	3.35	3.40	2.20	2.23	1.88	1.93
T_7 – Lemon grass oil at 0.2 %	73.0	75.0	3.50	3.60	2.25	2.28	1.91	1.95
T_8 – Both at low concentration	77.0	80.0	3.80	3.90	2.38	2.41	1.98	2.01
T_9 – Both at medium concentration	80.0	84.0	3.90	3.98	2.42	2.45	2.04	2.08
T_{10} – Both at high concentration	83.0	88.0	4.00	4.05	2.45	2.48	2.08	2.11
New L.S.D. at 5%	0.6	0.9	0.09	0.11	0.08	0.09	0.03	0.05

3. Some Physical and chemical characteristics of berries

Data in Tables (3 and 4) clearly show carrying out three sprays of nano-potassium and/or lemon grass oil, each at 0.05 to 0.2% which was significantly very effective in improving quality of berries in terms of increasing berry weight and dimensions, TSS%, total sugars%, TSS/ acid ratio, and reducing total acidity% relative the control treatment. The promotion was significantly correlated with using nano-potassium, relative to the application of lemon grass oil as well as with increasing concentrations of nano- potassium and lemon grass oil concentrations. Increasing concentrations of nano- potassium and lemon grass oil from 0.1 to 0.2% failed to show significant promotion on the quality in the vines that received both materials (nano-potassium and lemon grass oil) together than using each material alone. The best results were obtained due to using nano- potassium and lemon grass oil, each at 0.2%. Similar trend was noticed during 2022 and 2023 seasons.

Table 4. Effect of single and combined application of spraying nano-potassium and Lemon grass oil on some chemical characteristics of the berries of Flame seedless grapevines during 2022 and 2023 seasons

Characters / Treatments	TSS (%)		Acidity (%)		TSS / acidity		Total sugars %	
	2022	2023	2022	2023	2022	2023	2022	2023
T_1 – Control (water only)	17.5	17.7	0.690	0.685	25.3	25.8	15.3	15.5
T_2 – Nano potassium at 0.05%	18.5	18.8	0.630	0.615	29.3	30.6	16.4	16.6
T_3 – Nano potassium at 0.1 %	19.0	19.5	0.615	0.600	30.9	32.5	16.9	17.3
T_4 – Nano potassium at 0.2 %	19.4	19.9	0.600	0.590	32.3	33.7	17.2	17.6
T_5 – Lemon grass oil at 0.05%	18.0	18.6	0.670	0.650	26.8	28.6	16.0	16.5
T_6 – Lemon grass oil at 0.1 %	18.5	19.2	0.655	0.615	28.2	29.8	16.3	16.8
T_7 – Lemon grass oil at 0.2 %	18.8	19.5	0.640	0.630	29.4	30.9	16.5	17.1
T_8 – Both at low concentration	19.5	20.0	0.590	0.580	33.1	34.5	17.3	17.8
T_9 – Both at medium concentration	19.9	20.4	0.575	0.750	34.6	35.8	17.7	18.2
T_{10} – Both at high concentration	20.1	20.8	0.550	0.540	36.5	38.5	18.0	18.5
New L.S.D. at 5%	0.5	0.6	0.017	0.015	1.1	1.3	0.3	0.4

Discussion

Effect of potassium

Potassium is the most abundant cation in the plant tissue and plays a critical role in overall plant health (Mpelasoka *et al.,* 2003). Potassium is necessary for cellular osmoregulation, enzyme, electrochemical process, cell division, photosynthesis and for protein and carbohydrate synthesis and transportation (Centinari, 2016 and Karimi *et al.*, 2014).

A reduction in the acidity, not only on quality parameter has been noted to be influenced by the application of potassium, soluble solids, maturity and anthocyanins levels. A reduction in colour intensity and uneven berry ripening was noted by (Morris *et al.,* 1980).

The conventional fertilizers contain particles of size exceeding 100 mm making them difficult to be absorbed by the plants which results in low element utilization efficiency by plants. Hence many trials have attempted to create nano- fertilizers to increase the element utilization efficiency by plants. (Kottegoda *et al.,* 2011; Gouma *et al.*, 2012; Xiaoyu *et al.,* 2013 ; Hu *et al.,* 2013 and Canadli *et al.,* 2014).

Effect of plant extracts

Plant extracts were used in many ways and their applications are promising in the long run in some fruit crops production (Srivastabva and Lal, 1997).

The importance of these materials on enhancing the growth, vine nutritional status, yield and fruit quality. In addition, the positive action of these plant extracts on stimulating the biosynthesis of TSS%, sugars and plant pigments surely reflected on advancing maturity and promoting fruit quality. These results are in agreement with those obtained by (Rizkalla, 2016; Ahmed *et al.,* 2016; Gouda, 2016; Refaai and Silem 2021; El- Senosy *et al.,* 2021; Ahmed *et al.,* 2021; Masoud *et al.*, 2023 and Abd El-Hady, 2025).

Conclusion

For promoting yield and quality of the berry of Flame seedless grapevines grown under Middle Egypt conditions, it is advised to spray the vines with a mixture of nano-potassium and Lemon grass oil, each at 0.1%, three times at growth start, just after berry setting, and at one month later.

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تأثير رش النانو بوتاسيوم وزيت حشيشة الليمون على المحصول وجودة حبات العنب الفليم اللابذرى

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الملخص

أجريت هذه الدراسة خلال موسمين متتاليين 2022 ، 2023 لاختبار تأثير رش النانو بوتاسيوم وزيت حشيشة الليمون بصورة فردية أو مشتركة بتركيز ما بين 0.05 الى 0.2 لكلا منهما على كمية المحصول وجودة حبات العنب الفليم اللابذرى. اجريت التجربة تحت ظروف التربة الطينية ومزروعة في مزرعة كروم خاصة تقع في قرية دروة مركز ملوى محافظة المنيا ، مصر. ولقياس تأثير المعاملات على الصفات الطبيعية والكيميائية للعنب الفليم استخدم تم تحليل النتائج المتحصل عليها احصائيا باستخدام القطاعات الكاملة العشوائية خلال موسمي الدراسة واظهرت النتائج ما يلى

كان هناك تحسن واضح وملحوظ في كمية المحصول معبراً عنها في صورة عدد العناقيد للكرمة والوزن بالكيلوجرام وكذلك وزن وطول وعرض العنقود وذلك عند زيادة التركيز المستخدم من 0.05 الى 0.2% من مركب النانو بوتاسيوم وزيت حشيشة الليمون مقارنة بالكرمات الغير معاملة. أدى معاملة الكرمات بالنانو بوتاسيوم وزيت حشيشة الليمون بمفردهما أو معا الى حدوث تحسن واضح في خصائص الجودة متمثلا في زيادة نسبة الحبات الملونة في العنقود وزيادة وزن الحبة وابعادها والنسبة المئوية للمواد الصلبة الذائبة الكلية والنسبة المئوية للسكريات الكلية وفى نقص النسبة المئوية للحموضة الكلية في العصير بالمقارنة بمعاملة الكونترول وكان التحسن في خصائص الجودة للحبات متناسبا مع زيادة التركيز المستخدم من النانو بوتاسيوم وزيت حشيشة الليمون.

وبالتالي من الضروري استخدام مخلوط من النانو بوتاسيوم وزيت حشيشة الليمون بتركيز 0.2% لكلا منهما رشا على الاوراق ثلاثة مرات في الموسم (في بداية النمو الخضري وبعد العقد مباشرا وبعد العقد بشهر) وذلك لأجل تحسين كمية المحصول كما ونوعا لكرمات العنب الفليم سيدلس النامية تحت ظروف مصر الوسطى

الكلمات المفتاحية: *النانو بوتاسيوم، زيت حشيشة الليمون، المحصول، الجودة، كرمات العنب الفليم سيدلس.*