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Effect of Some Organic Manures Tea on Superior Grapevine Yield and Physio-Chemical Quality

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Abstract: In contemporary agriculture, there is a pursuit for effective, sustainable, and eco-friendly alternatives that can enhance and preserve soil quality and fertility in the long term. The utilization of organic waste as fertilizer represents a significant approach toward achieving sustainable production. Recently, the application of innovative products derived from compost, such as compost tea and chicken manure tea, are gaining traction owing to their beneficial impacts on crops. This perspective aims to provide a contemporary assessment of the impact of substituting N-mineral fertilization with organic manure in agriculture. This research was conducted over the 2022 and 2023 seasons to assess the impact of various organic fertilization sources (compost tea and chicken manure tea) as a partial replacement for nitrogen minerals, and their influence on yield, and the physico-chemical quality of Superior grapevines compared with the full dose of N-mineral. Experiment was set at a private farm in Talla village, Minia Governorate. However, Increasing the nitrogen replaced ratio up to 40% (using 60% compost tea + 60% chicken manure tea) resulted a significant reduced in all yield and phyisico-chemical quality parameterizes. Superior grapevines productivity and quality significantly enhanced as a result of increasing the ratio of mineral N replaced by compost and chicken manure tea. On the opposite side, increasing the ratio of mineral N replacement till to 60% (using 40% compost tea + 40% chicken manure tea) caused a highest significant increase in yield (kg) and cluster parameters, physio-chemical berry quality and reduction in shot berry and total acidity. So, this treatment was the best in achieving the highest yield of Superior grapevines.

Key words: Mineral fertilization, organic fertilization, compost tea and superior grapevines.

1. Introduction

The grapevine (*Vitis vinifera* L.) is acknowledged as the most economically significant crop globally, positioned third in Egypt. The region in Egypt designated for grape cultivation spans 186,735 feddans, with the productive area being 175,245 feddans, yielding an overall production of 1,715,410 tons. The cultivated land in Minia Governorate reached 210,809 feddans, with a productive area of 20,852 feddans, yielding a total of 205,244 tons (**MALR, 2023**). Superior grapevine cv is widely

regarded as one of the most exceptional and frequently cultivated grape varieties in Egypt. The potential for export to foreign markets is increased as a result of the early maturation season, which commences in May and concludes in mid-June. Boosting export performance and preventing environmental contamination can be achieved by decreasing the quantity of mineral fertilizer utilized (**Ahmed and Nagib, 2018; El-Salhy *et al.*, 2023** and **Wassel *et al.*, 2024**).

Certain nutrient levels required for photosynthetic processes, metabolic pathways, and grapevine development must exist in order to sustain healthy growth and performance. The amount of each element required by the plant determines how essential elements and the related macro- or micronutrients are categorized. If a single ingredient is not available in adequate amounts, its availability impacts how well a vine performs. Availability, not element concentration, is often the limiting factor when micronutrient deficits are observed. Unique foliar symptoms and a restricted growth habit might result from individual essential element toxicity or deficiency (**Ashley, 2011**)

Soil fertilization is a cultural practice that significantly influences grape yield and quality. Nitrogen (N) is crucial for grape growth, serving as the primary compound for shoot and leaf development. The seasonal dynamics of nitrogen are established and involve its translocation from woody perennials to newly formed organs during the period from budburst to flowering. Beginning in spring, roots primarily absorb this macronutrient in the nitrate form, achieving peak adsorption rates from bloom to fruit set (**Cocco *et al.*, 2021**). Conversely, uptake declines from veraison to leaf fall, as nitrogen stored in annual organs is reallocated to woody tissues (**Schreiner, 2016**). N deficiency and excess can both negatively impact yield and fruit quality. Nitrogen is typically applied starting in late winter, directly to the soil primarily in the forms of nitrate, ammonium, amide, or amino acid. Nitrogen requirements for grapevines are widely recognized as relatively low, typically amounting to less than 100 kg ha^{-1} throughout a crop cycle (**Thiebeau *et al.*, 2005**).

Organic fertilization diminishes the reliance on agrochemicals. Organic fertilization, is a critical cultural activity during the growth season. Organic fertilization serves as an alternative approach to supplying the macro and micronutrients essential for plant growth. The beneficial impact of these natural biostimulants can be ascribed to their rich composition of diverse nutrients, including organic acids, organic matter, antibiotics, B vitamins, amino acids, and natural hormones such as angiotensinic acid IDAA, GA_3, and cytokinins (**Akl *et al.*, 2017**). Organic fertilizer facilitated the growth of grapevines and improved their nutritional status. Additionally, organic compounds decrease soil pH and improve soil structure, aeration, and moisture retention. Producing fruits organically through organic fertilization, rather than chemical fertilizers and stimulants, is now essential (**Birjely & Al-Atrushy, 2017; Al-Hawezy & Ibrahim, 2018 and Hassan & Salem, 2020**).

Compost tea, also known as compost extract, is generated from the fermentation of compost in water (**Litterick *et al.*, 2004**). It has been employed in agriculture as an effective source of organic matter and soil amendment, supplying plants with essential mineral nutrients (**Abbasi *et al.*, 2002**). Furthermore, it contains a high concentration of growth regulators and phytohormones that enhance the activity of beneficial microorganisms, improve the physical and chemical properties of the soil, and inhibit certain plant disease pathogens (**Biocycle, 2004**). **Bayoumi and Hafez (2006)** indicated that compost tea notably enhanced all growth parameters, chlorophyll content, yield, and its quality when compared to the recommended dose of nitrogen.

This study aimed to investigate the impact of organic fertilization, specifically compost tea and chicken manure tea, as partial substitutes for inorganic nitrogen fertilizer on the qualitative and quantitative attributes of Superior grapevines berries under Minia condition.

2. Materials and Methods

2.1. Experimental location

This research was conducted over the 2022 and 2023 seasons to assess the impact of various organic fertilization sources as a partial replacement for nitrogen minerals, and their influence on growth, leaf nutrient status, yield, and the physico-chemical quality of Superior grapevines. Experiment was set at a private farm in Talla village, Minia Governorate. Prior to this experiment, soil samples were

collected from a depth of 0-30 cm to conduct physical and chemical analyses of the tested soil, as outlined by **Wilde *et al.* (1985**) in Table A.

Table (A). Physio-chemical analysis of the tested soil

Soil characters		2022/2023
Particle size distribution (%)	Sand	2.00
	Silt	36.89
	Clay	61.11
	Texture class	Clay
EC ppm (1:2.5 extract)		293
pH (1:2.5 extract)		7.89
Organic matter %		2.25
$CaCO_3$ %		2.56
Soil nutrients	Total N (%)	0.17
	Available P (ppm)	5.10
	Available K (ppm)	511.0
	Zn (ppm)	2.4
	Fe (ppm)	2.7
	Mn (ppm)	3.3
	Cu (ppm)	0.10

2.2. Treatment of the experimental

In this study, 15 vines approximately 10 years old exhibited comparable vigor and health, and were subjected to standard horticultural practices employed in vineyards cultivated at 2m within rows and 3m between-rows. The irrigation was sourced from the Nile using surface irrigation system. Cane pruned was used with a bud load of 84 buds per vine (6 canes X 12 eyes and 6 fruiting spurs X 2 eyes). A complete randomized block design was utilized in this experiment. Each treatment was represented by one vine in three duplicates. The treatments were arranged as follows:

1) Control (100% N-mineral).
2) 80% N-Mineral+10% compost tea+10% chicken manure tea.
3) 60% N-Mineral+20% compost tea+20% chicken manure tea.
4) 40% N-Mineral+30% compost tea+30% chicken manure tea.
5) 20% N-Mineral+40% compost tea+40% chicken manure tea

Each treatment was administered with the recommended dosage of nitrogen at 80g N per vine per year was added in the form of ammonium nitrate (33.5% N)+organic manure at four dosages with one-month intervals between them.

2.3. Preparation of organic manure tea

Fresh compost and chicken manure were sourced from two farms in close proximity to the location. The manure was contained in burlap bags, each weighing 2 kg. These bags were subsequently positioned in plastic drums filled with 20 liters of water. A rock was added to the manure to ensure it remained submerged and did not float. The barrels were subsequently covered with plastic wrap to finalize the fermentation process. The burlap bags were manually moved up and down several times each day. Following a three-week fermentation period, the two organic manure teas are now prepared for application. The subsequent Tables (B and C) present the chemical composition of the organic

manure tea utilized in the experiment (**Price and Duddles, 1984**). Compost and chicken manure tea were used as organic fertilization as soil addition.

Table (B). Chemical analysis of compost tea according to Abd El–Hamied and El-Amary (2015)

EC (dS/m)	Ph	N ppm	P ppm	K ppm	Ca ppm	Mg ppm	Fe ppm	Zn ppm
0.812	6.55	251	7.5	212	85	119	64	7.1

Table (C). Chemical analysis of chicken manure tea according to Akl *et al.*, (2017)

Parameters	Values
O.M. %	58.26
Organic carbon	27.90
pH (1 : 2.5 extract)	10.25
E.C. (ds/m) (1: 2.5 extract)	5.9
Total N %	2.5
Total P %	1.12
Total K %	1.21
Total Fe (ppm)	18.5
Total Zn (ppm)	43.22

2.4. Measurements included:

2.4.1. Characteristics of clusters and yield

The following data was determined by harvesting four clusters per vine during the maturation stage: Cluster number/vine, cluster weight (g), cluster length (cm), cluster shoulder (cm), yield (kg)/vine was assessed in kg for each tree/replicate by the following equation; cluster number × cluster weight and berry setting (%) was computed as the following: Prior to blooming, five flower clusters per vine were placed in perforated paper bags; these were released during berry set and were computed as follows.:

$$\text{Fruit berry Setting\%} = \frac{\text{Number of berries /cluster}}{\text{Total number of flower /cluster}}$$

2.4.2. Physical characteristic of the berry

- The shot berry proportion was determined by the following equation

$$\text{Shot berry\%} = \frac{\text{The percentage of berries in each cluster}}{\text{The total number of berries/cluster}} \times 100$$

- Berry weight (g) and berry dimensions (longitudinal and equatorial).

2.4.3. Chemical characteristics of berries according to (**A.O.A.C, 2000**)

TSS% in berries were determined using a hand-held refractometer, titrating 5 ml of berry juice against 0.1 N NaOH with phenolphthalein determined the titratable acidity percentage, TSS/acidity ratio of berry juice was calculated, reducing sugar% and Juice%

2.5. Data Analysis

According to **Mead *et al.* (1993)**, the NEW L.S.D. technique was used to assess all data at a 5% level.

3. Results and Discussion

3.1. Yield and cluster characteristic

Across the 2022 and 2023 growing seasons, Table 1, show the impacts of various dosages (10, 20, 30 and 40%) for each one of compost tea and chicken manure tea replacement with N-mineral (20, 40, 60 and 80%) on Superior grapevine yield and physical characteristics of cluster, such as cluster number per vine, weight, yield in kg per vine, berry setting %, cluster length, and shoulder.

From the given data in Table (2) it can be clearly shown that all treatments under investigation affected in yield and cluster parameters during two seasons, except cluster number in the first season didn't affect by all treatments. Increasing soil addition of organic manure (compost tea and chicken manure tea) concentration and replacement with dosage of N-mineral increased as cluster number per vine, weight, yield in kg per vine, berry setting %, cluster length, and shoulder until dosage of 20% N-Mineral+40% compost tea+40% chicken manure tea, which recorded lowest value (320.0 - 323.0 g for cluster weight), (23-17 for cluster number), (7.4-5.4 for yield kg/vine), (7.2-17.3 % for berry setting), (18.8-18.9 cm% cluster length) and (11.1-11.3 cm for cluster shoulder). While, the highest mean values scored with 60% N-Mineral+20% compost tea+20% chicken manure tea (343.0 - 349.0 g for cluster weight), (24-33 for cluster number), (7.9-11.5 for yield kg/vine), (9.7-9.9 % for berry setting), (20.8-21.2 cm cluster length) and (13.1-13.3 cm for cluster shoulder), followed by 80% N-Mineral+10% compost tea+10% chicken manure tea (337.0 - 343.0 g for cluster weight), (24-29 for cluster number), (7.8-9.9 for yield kg/vine), (9.1-9.3 % for berry setting), (20.3-20.7 cm cluster length) and (12.6-12.8 cm for cluster shoulder) during two seasons, respectively.

The positive effects of organic fertilizers on yield, cluster weight, and berry weight can be attributed to their ability to supply vines with essential nutrients (both macro and micro elements) over an extended period. This, in turn, enhances the nutritional status of the vines and supports vegetative growth, ultimately benefiting yield and cluster weight **(Nijjar, 1985).** Furthermore, the role of using manure tea was extended study by **Akl *et al.* (2017)**; **Slama *et al.* (2019); Abd EL-Rahman *et al.* (2021); Wassel *et al.*, (2024)**.

Table (1). Response of Superior grapevine yield and cluster parameters to some organic manures tea during 2022 and 2023 seasons

Characteristics / Treatments	Cluster weight (g)		Number of cluster/vine		Yield/vine (kg)		Berry setting %		Cluster length (cm)		Cluster shoulder (cm)	
	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023
Control (100% N-mineral)	330.0	335.0	23	24	7.6	8.0	8.3	8.5	19.7	20.0	12.0	12.3
80% N-Mineral+10% CT+10% CMT	337.0	343.0	24	29	7.8	9.9	9.1	9.3	20.3	20.7	12.6	12.8
60% N-Mineral+20% CT+20% CMT	343.0	349.0	24	33	7.9	11.5	9.7	9.9	20.8	21.2	13.1	13.3
40% N-Mineral+30% CT+30% CMT	325.0	329.0	23	20	7.5	6.6	7.7	7.8	19.2	19.4	11.5	11.7
20% N-Mineral+40% CT+40% CMT	320.0	323.0	23	17	7.4	5.4	7.2	7.3	18.8	18.9	11.1	11.3
New LSD at 0.5	**5.0**	**6.0**	**N.S**	**3.0**	**0.3**	**1.0**	**0.4**	**0.4**	**0.4**	**0.5**	**0.4**	**0.4**

Compost tea: CT Chicken manure tea: CMT

3.2. Berry physical characteristics

Table 2 present the morpho-physical parameters of the "Superior" grapevine, including shot berry, average berry weight, longitudinal, and equatorial measurements. The morpho-physical parameters were compared to control treatments across the 2022 and 2023 seasons to assess the impact of organic manure fertilization (compost tea and chicken manure tea) at varying concentrations, replacing mineral-N dosages in comparison to 100% recommended dosage of mineral-N. These parameters are essential for effective marketing at local, regional, and global levels.

The obtained result suggested that there was variation of significance differences among all the treatments in both seasons. Table (2) present that clearly, the highest berries physical quality and lowest shot berry were found with 60% N-Mineral+20% compost tea+20% chicken manure tea (6.6- 6.4% for shot berry), (3.63- 3.68 g for average berry weight), (2.04-2.09 cm for berry longitudinal), and (1.97-2.03 cm for berry equatorial), while the shortest berry quality and highest shot berry were recorded by 20% N-Mineral+40% compost tea+40% chicken manure tea (10.2- 9.9% for shot berry), (3.30- 3.33 g for average berry weight), (1.80-1.85 cm for berry longitudinal), and (1.74- 1.77 cm for berry equatorial), with a significant difference with (100% mineral-N) "control", which recorded middle values (8.5- 8.2% for shot berry), (3.45- 3.50 g for average berry weight), (1.91-1.95 cm for berry longitudinal), and (1.84- 1.87 cm for berry equatorial), this mean that, soil addition of 20% from each compost tea and chicken manure tea saved 40% from N-mineral fertilization.

Table (2). Response of Superior grapevine shot berries, average berry weight (g), berry longitudinal and berry equatorial to some organic manures tea during 2022 and 2023 seasons

Characteristics / Treatments	Shot berries %		Average berry weight (g)		Average berry longitudinal (cm)		Average berry equatorial (cm)	
	2022	2023	2022	2023	2022	2023	2022	2023
Control (100% N-mineral)	8.5	8.2	3.45	3.50	1.91	1.95	1.84	1.87
80% N-Mineral+10% CT+10% CMT	7.4	7.3	3.55	3.61	1.98	2.03	1.92	1.96
60% N-Mineral+20% CT+20% CMT	6.6	6.4	3.63	3.68	2.04	2.09	1.97	2.03
40% N-Mineral+30% CT+30% CMT	9.4	9.1	3.36	3.40	1.84	1.89	1.78	1.81
20% N-Mineral+40% CT+40% CMT	10.2	9.9	3.30	3.33	1.80	1.85	1.74	1.77
New LSD at 0.5	**0.8**	**0.8**	**0.06**	**0.06**	**0.04**	**0.04**	**0.03**	**0.03**

Compost tea: CT Chicken manure tea: CMT

The findings can be attributed to the advantageous properties of compost tea, which is rich in macro and micronutrients and contains a significant quantity of beneficial bacteria, fungi, and actinomycetes (**Kassem, 2021**). Organic manure tea is an accessible fertilizer that positively influences the physical attributes of fruits especially when replacement with part of nitrogen dosage, aligning with the results obtained by **Alsalhy *et al.*, (2021); Abd EL-Rahman *et al.* (2021); Hamdy *et al.* (2022); Refaai and Soltan (2023).**

3.3. Berry chemical quality characteristics

The values for the chemical quality characteristics (TSS%, total acidity, TSS/acidity ratio, juice%, and reducing sugar) of grapevine cv. 'Superior' are elaborated upon in Table 3. These results are the result of the application of organic manure (compost tea and chicken manure tea) at varying concentrations, which replaced the mineral-N dosage in comparison to 100% mineral-N during the 2022 and 2023 seasons.

To assess the impact of compost and chicken manure tea applications on berries of Superior grapevines juice% (Table 2). The results showed under the different treatments and applications rate the TSS%, TSS/acidity ratio, juice%, and reducing sugar were significantly increased and total acidity was decreased by addition of compost and chicken manure tea replacement with N-mineral fertilization comparing with control (100% mineral-N). The highest TSS%, TSS/acidity ratio, juice%, and reducing sugar as well as lowest total acidity recorded at 60% N-Mineral+20% compost tea+20% chicken manure tea. The obtained data also, indicates that the application of 80% N-Mineral+10% compost tea+10% chicken manure tea was nearly with the previous treatment in improving berry quality as compared with control scored, which recorded the third place, during both seasons.

Table (3). Response of Superior grapevine chemical quality of berries to some organic manures tea during 2022 and 2023 seasons

Characteristics / Treatments	TSS%		Total acidity%		TSS/acidity ratio		Juice%		Reducing sugar%	
	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023
Control (100% N-mineral)	17.7	17.9	0.645	0.630	27.41	28.41	75.0	75.3	15.1	15.3
80% N-Mineral+10% CT+10% CMT	18.2	18.5	0.626	0.614	29.07	30.13	75.5	75.9	15.7	15.9
60% N-Mineral+20% CT+20% CMT	18.6	19.0	0.610	0.600	30.49	31.67	75.9	76.3	16.2	16.3
40% N-Mineral+30% CT+30% CMT	17.3	17.4	0.662	0.645	26.13	26.98	74.5	74.8	14.6	14.9
20% N-Mineral+40% CT+40% CMT	17.0	17.0	0.678	0.659	25.26	25.80	74.1	74.4	14.2	14.6
New LSD at 0.5	**0.3**	**0.4**	**0.016**	**0.014**	**1.13**	**1.17**	**0.3**	**0.4**	**0.3**	**0.3**

Compost tea: CT Chicken manure tea: CMT

The results obtained may be attributed to the richness of compost in macro and micro elements (**El Haggar *et al.* 2004 and Mohamed, 2008)**, which has a positive impact on the photosynthesis process. This indicates that an increased availability of sugar contributes to enhanced growth and fruit quality. Additionally, the enhancement effects of compost tea may stem from its critical roles in signal transduction systems, membrane stability and functions, the activation of transporter enzymes, and the metabolism and translocation of carbohydrates (**Bhaskaran *et al.*, 1985 and Smirnoff, 1996**). The positive impact of organic fertilizers on berry quality is primarily attributed to their significant contribution to enhancing organic foods, particularly in terms of total carbohydrates and plant pigments, as illustrated in Table 3. This improvement is evident in the advancement of berry quality and ripeness. The behavior of organic manure tea indicated herein are in complete agreement with **Hamdy *et al.* (2022); Muhammed *et al.* (2023**); **Refaai and Soltan (2023).**

4. Conclusion

Under Minia Governorate conditions similar conditions, it could be strongly recommended to replaced 60% N-Mineral+20% compost tea+20% chicken manure tea in order to improve vegetative growth and predictability of vines (yield "kg/vine", cluster parameters), nutritional status and fruit physic-chemical properties of Superior grapevines hereby achieving the highest yield of Superior grapevines.

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تأثير بعض الأسمده العضويه على المحصول و صفات الجوده لكرمات عنب سوبيريور

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الموجز

فى الزراعه الحديثه، هناك سعى دائم لإيجاد بدائل فعاله و مستدامه و صديقة للبيئة تؤدى إلى تعزيز جودة التربة و خصوبتها و الحفاظ عليها، لذلك يعتبر إستخدام الأسمده العضويه نهجاً هاما نحو تحقيق هذة الإستدامه. و وجد أنه فى الفتره الأخيره إكتسب إستخدام مستخلص الشاى الناتج عن الأسمده العضويه زخماً كبيراً نظرا لتأثيراتها المفيدة، مثل شاى الكمبوست و شاى زرق الدواجن. و يهدف البحث الحالى إلى تقييم تأثير إستبدال جزء من التسميد المعدنى النيتروجينى بإضافة شاى الكمبوست و شاى زرق الدواجن. لذلك أجريت تجربه فى مزرعة خاصة بقرية تاله بمحافظة المنيا على كرمات عنب سوبيريور عمرها ١٠ سنوات خلال موسمى ٢٠٢٢ و ٢٠٢٣م لتقييم تأثير إستبدال جرعة من التسميد النيتروحينى بشاى الكمبوست و زرق الدواجن مقارنه بالتسميد المعدنى بالجرعة الموصى بها. ووجد أن زياده نسبة الإستبدال للنيتروجين أكثر من ٤٠ % سماد نيتروجينى مع ٦٠% لكل من شاى الكمبوست و شاى زرق الدواجن أدى إلى إنخفاض فى صفات المحصول و الجوده الفيزيائية و الكيميائية. بينما تحسنت الصفات و سجلت أفضل القيم عند إستخدام ٦٠% سماد نيتروجينى مع ٤٠% لكل من شاى الكمبوست و شاى زرق الدواجن حيث سجلت أعلى القيم لصفات المحصول و الجوده مع إنخفاض نسبة الحبات الصغيره فى العنقود و الحموضة الكليه. و لذلك ينصح بإستخدام هذة المعالجه للحصول على أفضل محصول إقتصادى لكرمات العنب سوبيريور.

الكلمات المفتاحية: تسميد معدنى، أسمده عضويه، شاى كمبوست و عنب سوبيريور.