Impact of Grapevine Pruning on Water Use Efficiency, Vegetative Growth, Biochemical Content, Yield and Fruit Quality of Black Magic Grape

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ABSTRACT

Pruning is a critical component of grape production as it aims to maintain the balance between yield, fruit quality, and vegetative growth. This experiment carried out to study the effects of different cane lengths per vine on water use efficiency, vegetative growth, leaf biochemical, berry chemical & physical composition, and yield of Black Magic grapevines to determine the optimum cane length to leave on the vines to achieve the highest possible water use efficiency and yield with the best vegetative growth, chemical and physical composition while maintaining vine vigor during two consecutive seasons 2022 and 2023. Treatments were as follows: 14 canes with 4 buds, 14 canes with 5 buds, 14 canes with 6 buds, 14 canes with 7 buds, and 14 canes with 8 buds. Results revealed that all cane lengths per vine had a substantial effect on the examined attributes throughout both seasons. It was discovered that vines trimmed at 14 canes with 6 buds in both terms gave the best ethics of most studied features, such as water use efficiency, leaf area, shoot length, cane thickness, pruning weight, chlorophyll content, concentration of leaf mineral elements (nitrogen, phosphorous, potassium, and calcium), crude protein, total soluble solids, total anthocyanin content in berry skin, weight and volume of berry, berry firmness, total yield, and reduced total acidity. Pruning regulates production by selecting sufficient buds to match the vine's capacity, enhancing water use efficiency, yield and grape cluster quality, and contributing to more efficient and sustainable cultivation of Black Magic grapevine.

Keywords: Pruning- Water use efficiency- Vegetative growth- Chemical composition- Yield.

INTRODUCTION

Grapes (*Vitis vinifera* L.) are one of the world's largest and most valuable fruits, having great commercial value and several health advantages (Khadivi et al., 2019, EL Ghayaty et al., 2019 and Awad and Ahmed, 2025). Grapes are a widely popular fruit both locally and for export, thanks to their excellent flavor, taste, and high nutritional value. They are rich in minerals such as calcium, phosphorus, and iron, along with vitamins B1 and B2. Additionally, grapefruit juice serves as a mild laxative and a kidney drink (Kumar, 2017,Shaban and Ahmed,2021 and Ahmed,2023). Grapes are the world's third most important fruit yield, with 7.2 million hectares harvested and 70.8 million tons produced annually with an average yield of 11.23 tons per hectare (FAOSTAT, 2022). In Egypt, it ranks fourth behind citrus, mango, and olive fruit crops in terms of manufacture area and consumption rates. Grape acreage in Egypt has increased significantly over the previous decade, reaching 91,633 hectares and generating 1.517,976 tons (FAO, 2022).

Black Magic is a table grape variety, known for its good fruiting capacity and a fruiting coefficient of 1.19. It produces a high yield, typically ranging from 15 to 20 tons per hectare. Budding occurs in the third week of March, and the fruit ripens by the third week of July, making it an early maturing variety. The vine is robust, and the medium-sized leaves are five-lobed. Clusters range in size from medium to big, with a conical pyramid form and an average weight of 400 to 500 g. The fruit is medium-sized and egg-shaped, with a dark purple skin and copious bloom (Pizzuto, 2013).

Pruning is an important part of viticulture that involves taking out certain parts of the grapevine. It changes the microclimate, vine vigor, and canopy size, all of which affect how much water the plants need and how well they can take it in (Intrigliolo and Castel, 2010 and Al-Saif et al., 2023). Pruning maintains the balance between vegetative growth and fruit production by restricting the number of buds that mature into fruit-bearing branches. It can diminish canopy density, lower leaf transpiration and therefore water consumption. Furthermore, pruning affects the root-to-shoot ratio, which influences the vine's water intake and storage capacity, which is critical during times of water scarcity (Lovisolo et al, 2010 and Al-Saif et al., 2023). Grapevine cane length has been connected to a variety of biochemical parameters, including sugar and organic acid concentrations, as well as secondary metabolites such as flavonoids and anthocyanins. These biochemical features are not only crucial for plant growth, but they also have a considerable impact on fruit quality, impacting both table grapes production. The total of eyes remaining on the grapevine after winter trimming (pruning intensity minus fruit load) has a direct influence on growth, development, yield, and quality. Pruning intensity is highly impacted by cultivar, purpose of usage, rootstock, teaching technique, grapevine age and growth, and biological environments (Feitosa et al., 2018). Conscious winter and summer pruning helps to develop and maintain a physiological balance between vine vigor and yield quality. The arrangements made regarding yields have a direct impact on development and fruit quality (Friend and Trought, 2007).

Pruning is usually done throughout vine eco dormancy, from leaf fall to budbreak (Buesa et al., 2021). Pruning procedures have a direct impact on the number of shoots and prospective crop yield. Different pruning procedures may affect vine productivity, leaf area/crop ratio, and berry ripening duration (Allebrandt et al., 2017 and Teker and Altindisli, 2021). As a result, modifying the appropriate size of the fruiting units will surely impact crops and cluster characteristics. Many scientists have stressed the relevance of pruning in boosting output in relationship between quality and quantity (Gaser et al., 2017). The bud load of a grapevine is intricately connected to the plant's overall vigor and health, as well as its vegetative and reproductive performance from the previous year. To maintain a balance between fruit production and vegetative growth, it is essential to establish an appropriate load for each vine. A well-balanced vine will have sufficient vegetative growth to supply the necessary nutrients for full grape maturation, foster the development of fertile buds for the following season, and store adequate nutritionary investments (Jackson, 2008). The amount and distribution of nodes along canes and spurs are particularly significant in the management of cane-pruned vines (Epee et al., 2022). Recent research has highlighted the need for a better knowledge of how cane length affects biochemical properties in grapevines, particularly in terms of enhancing agricultural techniques and producing more robust cultivars. This study intends to investigate the link between cane length and important biochemical indicators such as enzyme activity, sugar metabolism, and phenolic content to contribute to more efficient vineyard management practices (Keller, 2015).

Efficient water management strategies are critical in the face of global water shortages, particularly in Mediterranean countries where water resources are becoming increasingly limited. Vineyards use a variety of pruning strategies, each having its own consequences for WUE (Costa et al., 2016). For example, spur pruning, which cuts vines down to short canes with only a few buds, tends to lower canopy density more efficiently than cane pruning, which maintains longer parts of the previous season's growth (Gatti et al., 2012). Therefore, agricultural research should shift its focus from maximizing total production to enhancing the availability of water.

Thus, the ultimate goal of this research is to determine the best cane length to leave on the vines in order to achieve the maximum possible water use efficiency and yield with the best fruit quality while maintaining vine vigor by comparing the effects of different cane lengths per vine on some leaf biochemical, berry chemical & physical characteristics, and yield of Black Magic grapevines, which can be recommended for cultivars under pruning systems.

MATERIALS AND METHODS

2.1. Plant material

This study was carried out on five-year-old 'Black Magic grapevines' (*Vitis vinifera* L.), grafted onto 'Freedom' grape rootstocks, grown in sandy soil under a drip irrigation system at a private vineyard located in Wadi Al-Natrun, Beheira Governorate, Egypt, over two consecutive seasons (2022 and 2023). Soil samples were randomly collected from for analysis, as outlined in Wilde et al. (1985), water and soil analysis results are provided in **Table (1),** quantity of the irrigation water applied as shown in **Table (2).**The vines were trained using the Spanish Parron system and pruning in late December, with a 2 x 3 meter spacing between vines. During both seasons, all selected grapevines were subjected to the same standard agricultural practices applied throughout the orchard.

Table (1). Water and soil compound analysis of the experimental site.

Water chemical properties									
pH	EC dS/m	Ca^{++} (mg/L)	Mg^{++} (mg/L)	Na^{+}	K^{+}	Cl^{-} (mg/L)	SO_4^{--}(mg/L)	HCO_3^{-}(mg/L)	CO_3^{--}
6.47	1.55	4.88	2.09	8.33	0.19	11.65	.34	3.50	0.0
Soil chemical characteristics									
Soil structure	EC (dS/m)	pH (1:2.5)	Soluble cations (meq/L)				Soluble anions (meq/L)		
			K^{+}	Ca^{++}	Mg^{++}	Na^{+}	Cl^{-}	HCO_3^{-}	SO_4^{-}
Sandy loam	1.68	8.81	.76	6.0	3.0	7.0	10.5	1.0	5.26

Table (2). Quantity of the irrigation water applied throughout the 2022 and 2023 seasons

Month	Dripper flow Amount ($L \cdot h^{-1}$)	Total of Drippers Per Vine	Irrigation Time ($h \cdot day^{-1}$)	Daily Water Quantity ($L \cdot vine^{-1}$)	Monthly Water Quantity ($L \cdot vine^{-1}$)
Sep	4	4	1 h, 30 m	24	720
Oct	4	4	0 h, 40 m	10.67	330.67
Nov	4	4	0 h, 25 m	6.67	200
Dec	4	4	0 h, 08 m	2.13	66.03
Jan	4	4	0 h, 09 m	2.40	74.40
Feb	4	4	0 h, 10 m	2.68	75.04
Mar	4	4	1 h, 00 m	16.00	496
Apr	4	4	1 h, 30 m	24	720
May	4	4	2 h, 00 m	32	992
Jun	4	4	2 h, 10 m	34.67	1040
Jul	4	4	2 h, 15 m	36	1116
Aug	4	4	2 h, 13 m	35.47	1099.57

Annual water quantity ($m^3 \cdot vine^{-1}$) = 6.93 m^3

Annual water quantity ($m^3 \cdot$ Feddan $^{-1}$) = 4850.66 m^3

2.2. Experimental design

The experiment included 75 vines (3 repetitions with 5 vines per replication) that developed identically to the crops and followed identical farming procedures. A randomized full block design was used to analyze the outcomes. Fertilization was carried out in the research region in accordance with Egyptian Ministry of Agriculture guidelines.

The tested treatments were arranged as follows:

T1: 14 canes with 4 buds (56 buds/vine).

T2 : 14 canes with 5 buds (70 buds/vine).

T3 : 14 canes with 6 buds (84 buds/vine).

T4 : 14 canes with 7 buds (98 buds/vine).

T5 : 14 canes with 8 buds (112 buds/vine).

2.3. Data recorded

2.3.1. Vegetative growth

2.3.1.1. Leaf area (cm^2): Used a portable leaf area meter (YMJ-A, Zhejiang Top Cloud Agri Technology Co., Ltd, China) to measure the average leaf area (cm^2) of twenty mature leaves abscised from the top of the developing stalk (6th or 7th leaf) at full bloom by Liu et al. (2015).

2.3.1.2. Shoot length (cm): Four non-fruiting shoots off the renewal spurs were randomly marked; two shoots at each side of the vine to measure shoot length, using a 1000 cm wind-up measuring, in the middle of May, and calculate the average shoot length (cm). The length of the ripened section of the shoot by the overall length of the shoot.

2.3.1. 3. Cane thickness (cm): Cane thickness was measured by using vernier caliper at winter pruning**.**

2.3. 1.4. Weight of pruning/vine (g): The "weight of pruning/vine refers to the mass of the pruned branches and other vegetative parts removed from a vine, typically grapevines, during seasonal pruning. This weight is measured to assess the vine's growth and vigor. The pruned material (shoots, canes, and branches) is gathered from each vine separately after pruning, the pruned material is placed on a scale to measure its weight.

2.3.2. Biochemical attributes in leaves

2.3.2.1. N, P, K and Ca content in leaf petioles (% D.W.): At full bloom, 24 leaf petioles were collected from opposite sides of the bunches, thoroughly cleaned with tap water, and dried at 70°C until a uniform weight was achieved. The petioles were then crushed to analyze their nitrogen, phosphate, potassium, and calcium content. The total nitrogen% was estimated using the micro-Kjeldahl method Jones (2001). Total phosphor: A calorimetric approach for determining phosphorus percentage in the sulfuric system that uses the stannus-reduced molybdophosphoric blue hue Jones (2001). The potassium concentration of digested plant components using a flame photometer Jones (2001). According to Carter (1993), calcium percentage was determined using an atomic absorption spectrophotometer.

2.3.2.2. Chlorophyll content (SPAD): Chlorophyll content in leaves at the cap of the growing stalk (6th or 7th leaf) at full bloom (SPAD unit) was measured using a chlorophyll meter (SPAD-502, Minolta Photography Co., Osaka, Japan).

2.3.2.3. Crude protein(%): Crude protein was estimated to multiply with the total Nitrogen by 6.25 method described by (A.O.A.C., 1990).

2.3.3. Yield characteristics

2.3.3.1. Berry biochemical characteristics: The biochemical components were determined as follows:

2.3.3.1.1.Total soluble solids percentage: The total soluble solid (%) was measured in 10 mL of berry juice filtrate using the digital refractmeter equipment (ATAGO H713214, Japan) specified in (A.O.A.C., 2000).

2.3.3.1.2. Total acidity: The total acidity of 10 mL of berry juice was measured. The titration technique was employed. The berry extract was combined with 100 mL of distilled water. Titration with 0.1 N NaOH was used to determine the total acidity percentage. Tartaric acid (%) corresponding to g/100 ml juice (A.O.A.C. 2000), was used to represent overall acidity.

2.3.3.1.3.TSS /acid ratio: The total soluble solids (TSS)/acid relation for all samples was estimated using the following formula: TSS/acid ratio = TSS / total acidity.

2.3.3.1.4. Total anthocyanin (mg/ 100g F.W.): The total anthocyanin content in berry skin was determined using the method described by Mazumdar and Majumder's (2003). This involved extracting half a gram of fresh fruit in 10 ml of an ethanol-hydrochloric acid combination, able to be combining 85 parts of 95% ethanol with 15 parts of 1.5 N hydrochloric acid. The mixture was left to stand overnight at approximately 4°C, then centrifuged for 3 minutes and filtered through filter paper. The solution's optical density was then measured using a spe.

The following formulae were used to compute the total anthocyanin content in berry skin: Total anthocyanin value for the berry skin (per 100g) = E x B x C / D x A

Where: A represents the weight of the sample. B= The volume is used for color measurement. C = total volume produced. D = volume of aliquot used for estimate. E = represents the specific optical density value at 535 nm wavelength.

2.3.3.2. Berry physical parameters:- At harvest, on the first of June, a characteristic sample of five clusters from each replication was taken to determine:

2.3.3.2.1. Average weight of 100 berry: The average berry weight (g) was calculated by weighing 100 randomly picked berries from each of the 10 selected clusters on a benchtop digital scale and then averaging each vine.

2.3.3.2.2. Average volume of 100 berry: The average berry volume (cm^3) was estimated by size 100 randomly picked berries for each cluster of the ten chosen clusters using the graduated cylinder.

2.3.3.2.3. Berry firmness (lp/inch^2): Firmness was measured using an FT-02 hand-held digital penetrometer.

2.3.3.3. Total Yield: Individual vine yields were measured, and the average yield/vine was calculated. To determine the average yield/feddan, the yield per vine was multiplied by the number of vines/ feddan, and the result was expressed in tons at the time of harvest.

2.3.4. Water use efficiency (WUE): Water use efficiency was estimated corresponding to Payero et al. (2009), as follows: Crop yield (kg/fed)/applied irrigation water (m^3/fed)

2.3.5. Data analysis: The Costat V6-303 statistical software was used to analyze the physical, physiochemical, and phytochemical data obtained from the complete random design using analysis of variance (ANOVA). The treatment means were compared to those with the highest significant changes (Duncan's test) at the 0.05 level.

RESULTS and Discussion

3.1. Vegetative growth:

The influence of cane length on vegetative growing traits, including shoot length, leaf area, cane thickness and pruning weight, is presented in **Fig. (1)** of Black Magic grapevines throughout 2022 and 2023. The results obtained proved the outperformance of 14 canes with 6 buds over other treatments significantly increasing shoot length, leaf area, cane thickness, and pruning weight in both seasons. The determination of the appropriate bud load of Red Globe and Black Monukka cultivars was the main target of the investigation applied by Sabry et al. (2020). They studied the effect of cane length and numbers on vegetative growing characteristics. The results proved the superiority of the 15 canes x 8 buds/cane treatment for shoot length, shoot diameter, and weight of pruning with the Red Globe cultivar. Whereas the vines of the Black Monukka cultivar trimmed at 8 canes x 15, buds/cane produced the highest values of the tested vegetative growth parameters.

There was a corresponding decrease in the number of canes and an increase in cane length with these increases (Mohamed et al. (2023). Also, Cangi and Kılıç (2011) investigated the effects of several bud loading levels in winter pruning and nitrogen doses on yield and the physical and chemical properties of fresh vine leaves of the grape cultivar "Narince." winter pruning improves leaf area for physical properties, and dry matter. A small cane length (bud load/vine) can improve vegetative growth parameters by reducing shoot competition and increasing lateral bud bursting, growth, and leaf elongation (Bassiony, 2020).

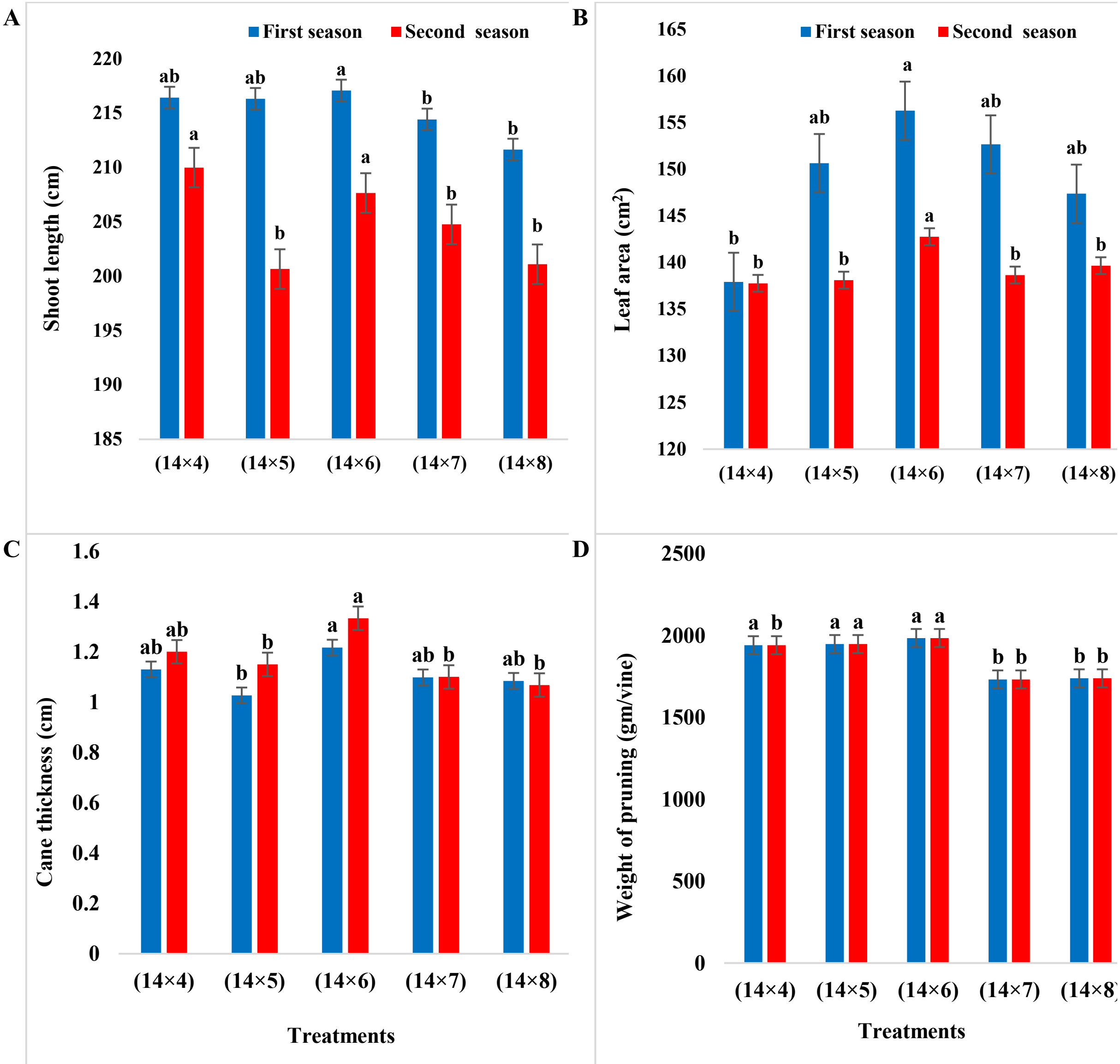

Fig. (1). Effect of cane length on (A) shoot length (cm), (B) leaf area(cm^2), (C) cane thickness (cm), and (D) weight of pruning (gm/vine) of Black Magic grapevines during 2022 and 2023 seasons.

3.2. Biochemical attributes in leaves:

3. 2.1. N, P, K and Ca percentage in leaf petioles:-

The influence of cane length on the mineral content of leaves, including N, P, K, and Ca, is shown in **Fig. (2).** N, P, K, and Ca percentage in leaf petioles were found vines trimmed at 14 canes with 6 buds (84 buds/vine), which provided the significant greatest values of Black Magic grapevines throughout the 2022 and 2023 seasons. Several prior studies have explored the influence of cane length on nutritional components in grapes, such as on Superior grapevines, the vines trimmed to leave 102 nodes/vine had the maximum amounts of N, P, K, and Ca in the leaves Ali et al. (2016), in research on Autumn Royal grapevine pruning severity had a favorable effect on vegetative growth indices as well as total N, P, and K content in leaf petioles Ghobrial (2018).

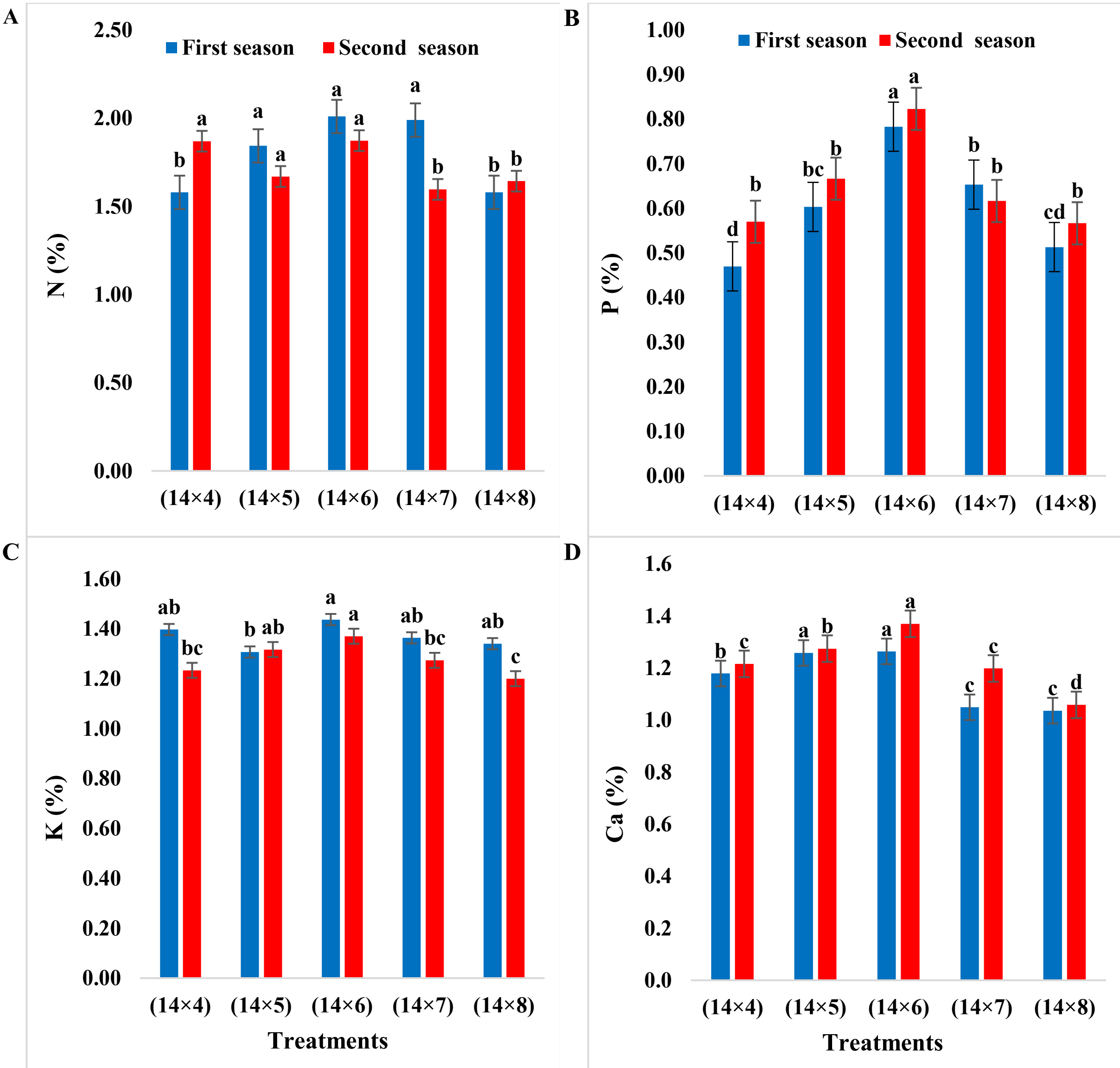

Fig. (2). Impact of cane length on leaf content of (A) Nitrogen, (B) Phosphorus, (C) Potassium, and (D) Calcium of Black Magic grapevines throughout 2022 and 2023 seasons.

3.2.2. Chlorophyll content and crude protein:

The data in **Fig. (3)** reveal that the varied cane length per vine of Black Magic grapevines influenced chlorophyll content and crude protein over the 2022 and 2023 seasons. The results are shown in **Figure(2)** found that grapevines trimmed at 14 canes with 6 buds had the maximum chlorophyll content in leaf in both seasons. Grapevines trimmed at 14 canes with 7 produced the lowest chlorophyll content in both seasons. Grapevines trimmed at 14 canes with 6 buds had the maximum crude protein value in both seasons, while grapevines pruned at 14 canes with 4, 14 canes with 8 buds in the first season, and 14 canes with 7 buds in the second season had the last. The ideal bud load per vine for Crimson seedless grapevines. were selected and cut at six different levels of bud load. The vines with 78 buds / vine had the lowest total protein content over both seasons of the trial Fawzi et al. (2010). The greatest levels of chlorophyll (a and b), total chlorophylls, in the leaves were measured on vines clipped to leave 102 nodes per vine of Superior grapevines Ali et al. (2016).

The length of the cane has a considerable effect on the nutritional makeup and chlorophyll content of grape leaves. According to studies, longer canes with moderate trimming generate increased leaf chlorophyll content, which improves the vine's photosynthetic potential. Longer canes improve nutrient distribution throughout the vine, promoting optimal leaf function and development. Furthermore, cane length influences nutrient levels such as nitrogen, phosphorus, and potassium, which affect overall vine production and berry quality (Senthilkumar, 2015).

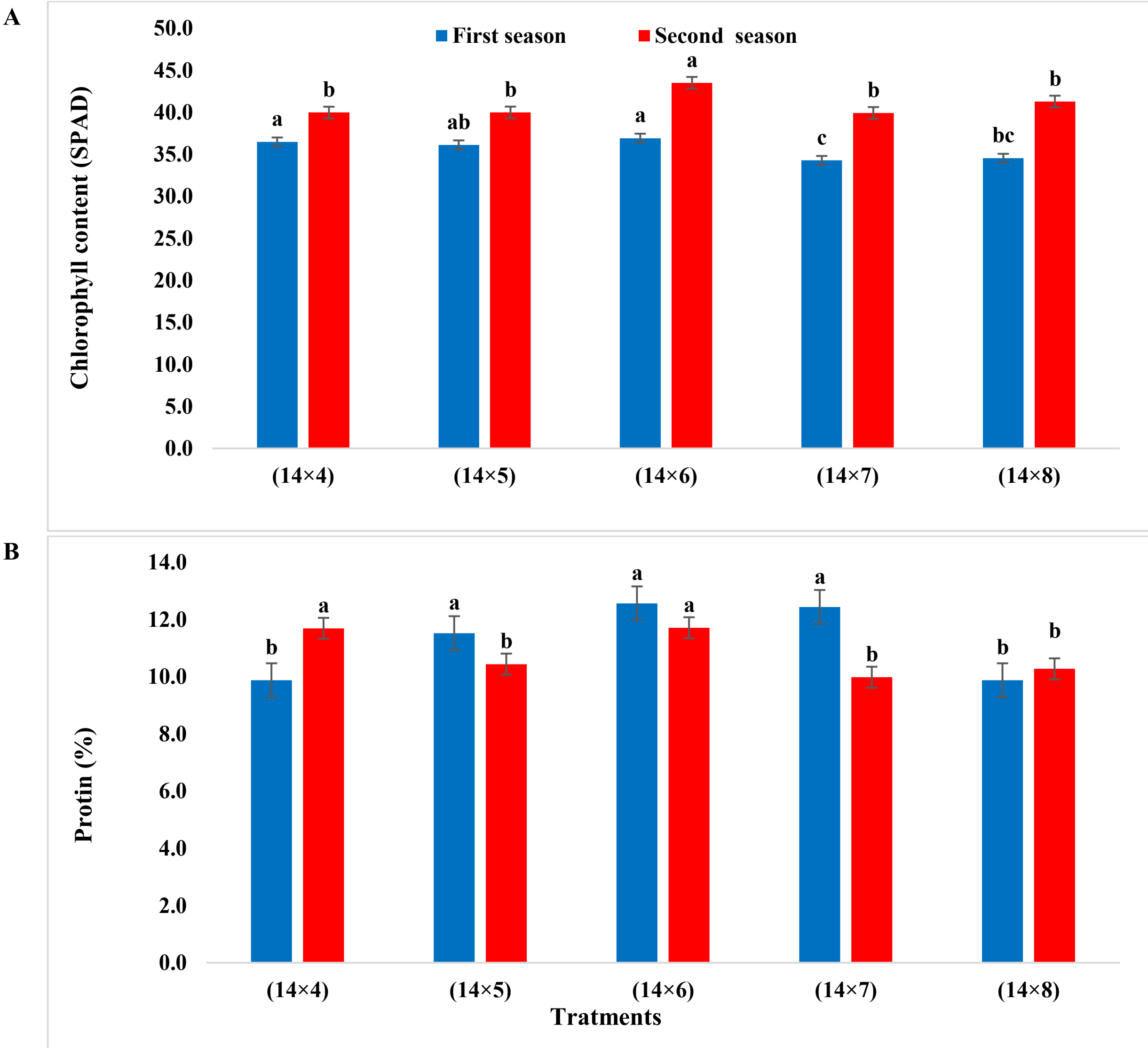

Fig (3). Impact of cane length on (A) chlorophyll content, and (B) crude protein of Black Magic grapevines throughout 2022 and 2023 seasons.

3.3. Yield characteristics:

3.3.1. Berry biochemical characteristics:-

During the 2022 and 2023 seasons, data in **Fig. (4)** show that different cane lengths per vine of Black Magic grapevines had a significant effect on berry biochemical characteristics such as percentages of total soluble solids (T.S.S), total acidity (TA%), TSS/acid ratio, and total anthocyanin in berry skin . Vines trimmed at 14 canes with 6 buds had the greatest (T.S.S %), TSS/acid ratio, and total anthocyanin levels in both seasons. In terms of total acidity, grapevines trimmed at 14 canes with 8 buds, 14 canes with 7 buds in the first season, and 14 canes with 7 buds in the second season had the highest values in both seasons. Differences in cane length resulted in variations in T.S.S. %, total acidity, and T.S.S/acid of the Black Magic grape variety Mohamed (2023). In the same context, the impact of bud loading on biochemical characteristics of Midnight Beauty increased T.S.S. and total anthocyanin levels in berry skin Feitosa et al. (2018) and Gaser et al. (2024).

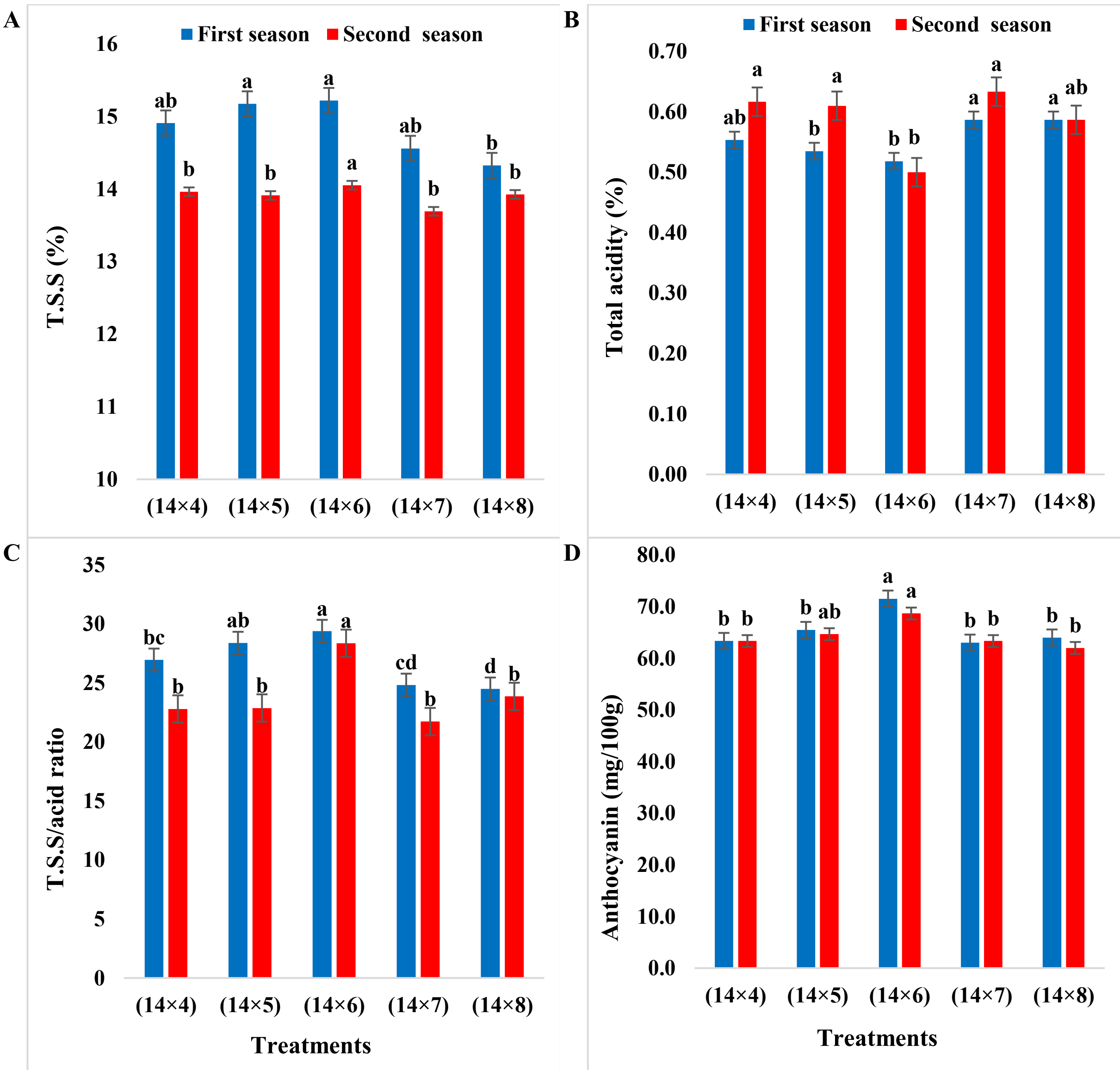

Fig (4). Impact of cane length on total soluble solids percentage (A), total acidity percentage (B), TSS / acid ratio (C), and total anthocyanin in berry skin (D) of Black Magic grapevines throughout 2022 and 2023 seasons.

3.3.2. Berry physical parameters:

During the 2022 and 2023 seasons, data in **Fig. (5)** reveal that varied cane lengths per vine of Black Magic grapevines substantially influenced berry physical characteristics such as average weight and volume of 100 berries and berry firmness (Ib/inch^2). Vines pruned at 14 canes with 6 buds beat other treatments in terms of average 100-berry weight and volume, as well as berry firmness. In terms of cane length's impact on berry physical characteristics, rigorous and balanced pruning resulted in the greatest weight values per 100 berries Bassiony (2020). As the number of buds or canes decreased, weight and volume of 100 berries increased, while a better bud load produced the down rates Khamis et al. (2017). Additionally, pruning severity and cane length influenced the production and fruit quality of 'Early Sweet' grapevines. Pruning at 56 buds per vine, with 4-5 buds per cane, improved berry quality. Vines pruned to 56 buds and five buds per cane improved the firmness berries Diab (2015).

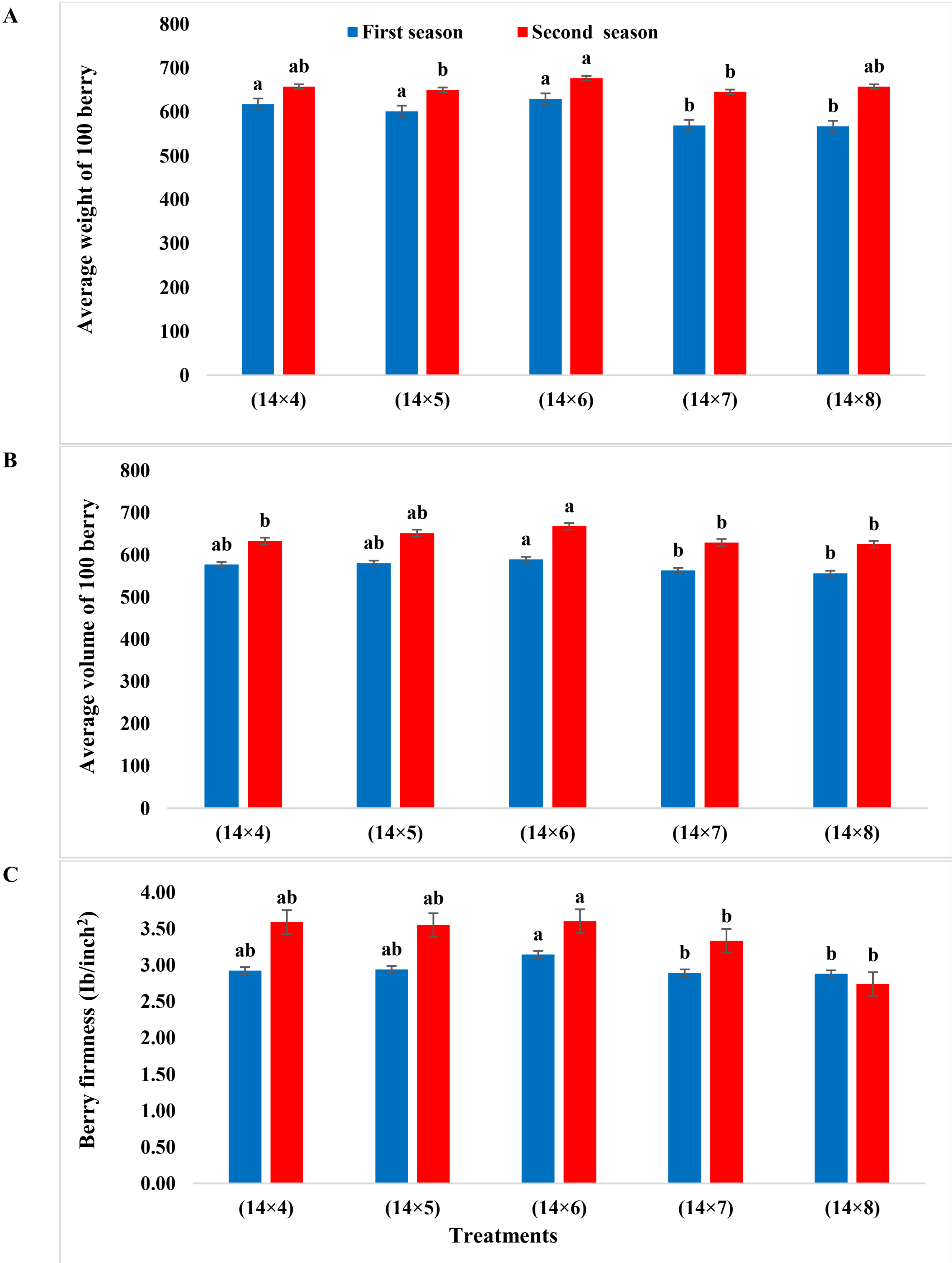

Fig (5). Effect of cane length on (A) average weight of 100 berry, and (B) average volume of 100 berry, and (C) berry firmness of Black Magic grapevines during 2022 and 2023 seasons.

3.3.3. Yield

Figure 6 depicts the influence of cane length per vine on Black Magic grapevines output over the seasons 2022 and 2023. In terms of cane length yield (kg/vine) and yield (Feddan/ton), statistics reveal that grapevines trimmed at (14 canes with 6 buds) produced considerably higher values in both seasons.

In contrast, the extreme pruning treatment produced the lowest yield (kg/vine) and yield (ton/Feddan), with (14 canes with 8 buds) in the first season and (14 canes with 5 buds) in the second season.

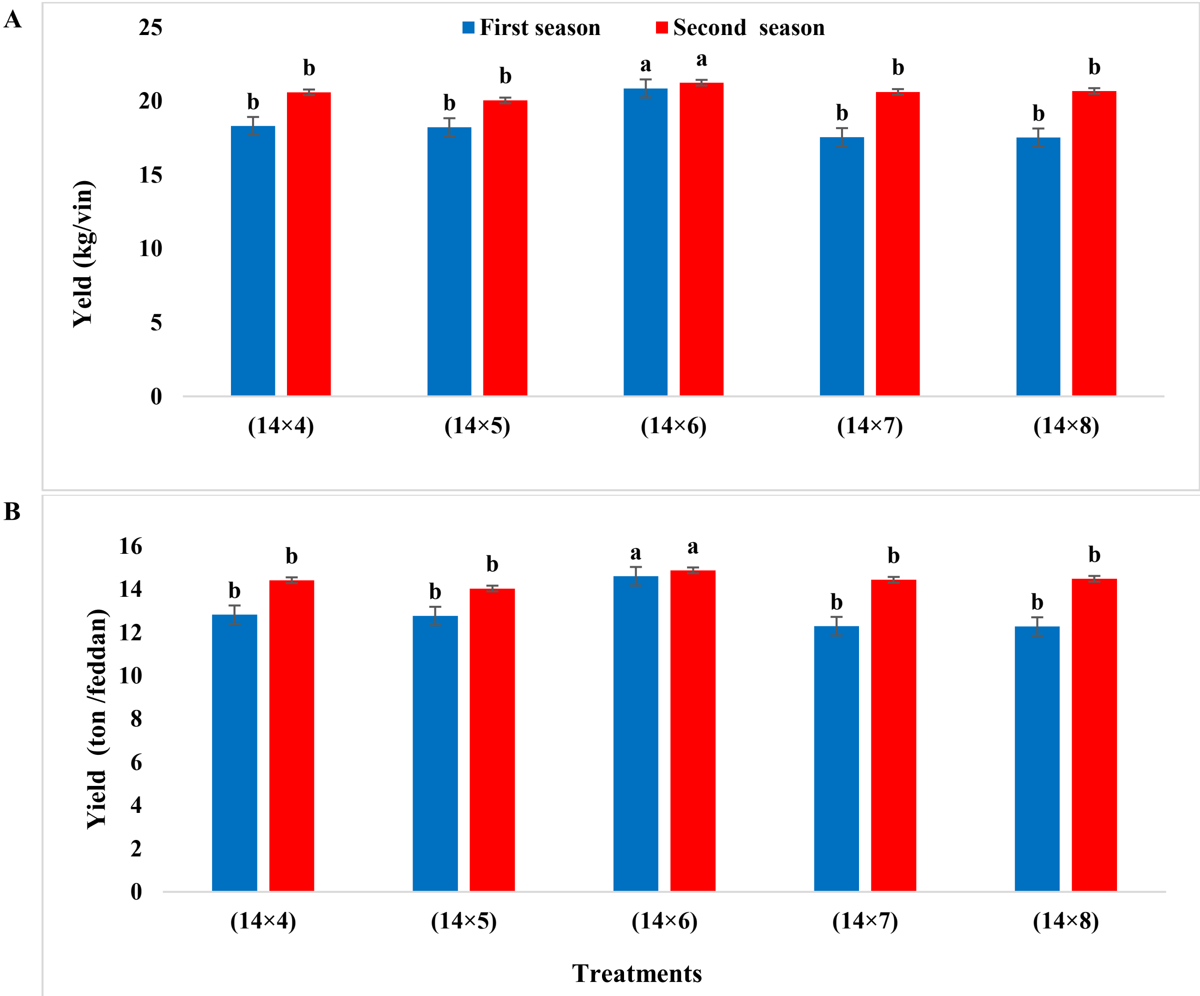

Fig (6). Effect of cane length on (A) yield (kg/vin), and (B) yield (ton /feddan) of Black Magic grapevines during 2022 and 2023 seasons.

3.4. Water use efficiency:

The data presented in **Fig. (7)** show the water use efficiency of Black Magic grapevines under different cane length-affected treatments during the 2022 and 2023 seasons. The data reveal that grapevines trimmed at 14 canes with 6 buds caused in the greatest water use efficiency in both seasons. It is also evident that vines with 14 canes with 7 buds had the lowest water use efficiency in both seasons.

The findings are similar with (Fidelibus, 2021), who showed that grapevines by lengthier canes produced smaller amount clusters related to those with petite canes, which may clarify why the amount of clusters did not increase in direct proportion to the number of canes and nodes. Furthermore, the length of canes / vines had no influence on the total of clusters, and there were no interactions between cane count and bud load level. In contrast, Abdel-Hamid et al. (2015) improving bud load resulted in much decreased crop / vine. This decline in vine output might be ascribed to a drop in cluster or vine weight, as well as an increase in bud load from Autumn Royal seedless grapes. Furthermore, increasing the number of buds / vine from 8 buds/m^2 (60 buds/vine) to 12 buds/m^2 (90 buds/vine) resulted in an increase in yield/vines and Feddan of Flame seedless grapevines Belal et al. (2021). Growing leaves result in a dense canopy with increased active photosynthesis and stored carbohydrates in grapevine canes, which may explain the rise in production and qualities Omar and Abdel-Kawi (2000).

On the other side, judicious pruning has a positive influence on leaf area, elements, and chlorophyll content, which leads to increased grape output and fruit quality Ali et al. (2016). Pruning may enhance canopy management by balancing vegetative growth and fruit load, which is critical for effective water usage Medrano et al. (2015). Precise winter pruning, along with managed deficit watering, enhanced water usage efficiency and production in vineyards Bellvert et al. (2021). Canopy management, especially trimming, is critical for increasing water efficiency and maintaining grape output in the face of a water shortage (Chaves et al., 2010 and Bashir et al., 2021).

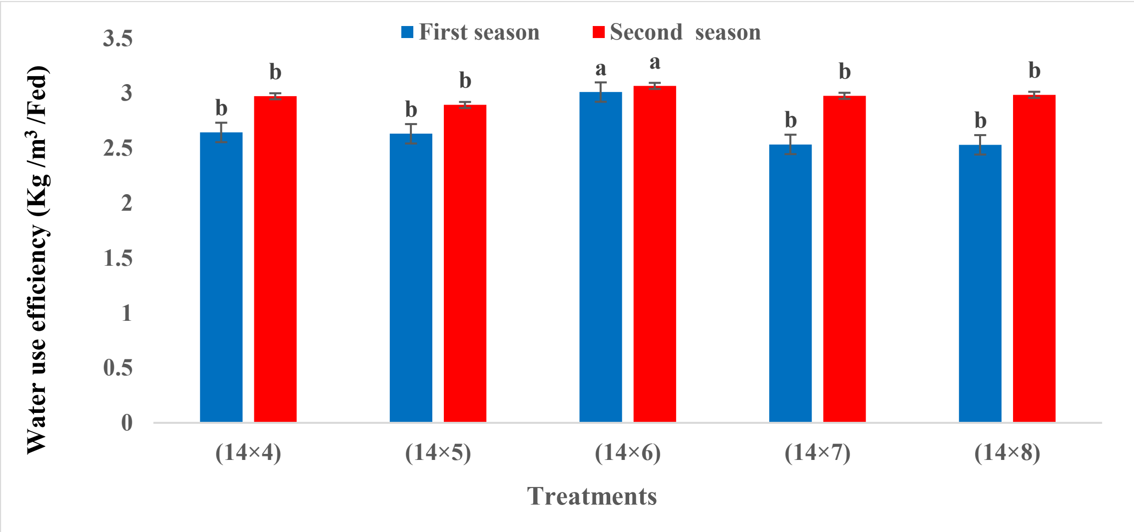

Fig. (7). Effect of cane length on water use efficiency of Black Magic grapevines during 2022 and 2023 seasons.

CONCLUSION:

Under the conditions of Wadi Al-Natron, Beheira Governorate, vines trimmed at (14 canes with 6 buds) produced the greatest of water use efficiency leaf biochemical, berry chemical and physical characteristics, and yield of the Black Magic grape cultivar. These findings indicate that good pruning process may have a considerable impact on grapevine performance, and the treatment of 14 canes with 6 buds provides a practical and efficient method for increasing the produce and quality of Black Magic grapevines. Further research might look at additional elements to improve grapevine management practices for the best results. As a result, the following recommendations are made to maximize potential output while maintaining vine vitality. This is appropriate for farmers' revenue as well as for domestic and foreign markets. Therefore, production may be controlled by pruning, since enough buds are chosen to give the quantity of clusters the plant can hold until it yield. As a result, it is vital to assess the influence of different pruning intensities on the performance of every grape cultivar in today's shifting environmental circumstances. So, pruning treatment is suitable for improving the production of high-quality grapes suitable for local and export markets of table grapes.

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الملخص العربي

تأثير تقليم كرمات العنب على كفاءة استخدام المياه، النمو الخضري، المحتوى البيوكيميائي، المحصول، وجودة ثمار العنب بلاك ماجيك

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يُعدّ التقليم عنصرًا أساسيًا في إنتاج العنب، إذ يهدف إلى الحفاظ على التوازن بين المحصول وجودة الثمار والنمو الخضري. أُجريت هذه التجربة لدراسة تأثير اختلاف أطوال القصبات لكل كرمة على كفاءة استخدام المياه، والنمو الخضري، والتركيب البيوكيميائي للأوراق، والخواص الطبيعية والكيميائية للثمار، وإنتاجية كروم عنب البلاك ماجيك. لتحديد الطول الأمثل للقصبات الذي يجب تركه على الكروم لتحقيق أعلى كفاءة ممكنة في استخدام المياه، وأفضل إنتاجية، مع الحفاظ على حيوية الكروم، وذلك خلال موسمي 2022 و2023. شملت المعاملات خمس مستويات من التقليم: 14 قصبة بكل منها 4 عيون، 5 عيون، 6 عيون، 7 عيون، و8 عيون. وقد أظهرت النتائج أن جميع المعاملات كان لها تأثير معنوي على الصفات المدروسة خلال الموسمين. وأوضحت النتائج أن تقليم كرمات العنب إلى 14 قصبة بكل منها 6 عيون قد تفوقت من حيث معظم الصفات المدروسة، ومنها: كفاءة استخدام المياه، مساحة الأوراق، طول الطراح، سمك القصبات، وزن قصاصات خشب التقليم، محتوى الكلوروفيل في الورقة، تركيز العناصر المعدنية في الأوراق (النيتروجين، الفوسفور، البوتاسيوم، والكالسيوم)، نسبة البروتين الخام، المواد الصلبة الذائبة الكلية، الحموضة الكلية، محتوى الأنثوسيانين الكلي في قشرة الحبة، وزن وحجم الحبة، صلابة الحبات، والمحصول الكلي. كما تشير النتائج إلى إمكانية التحكم في إنتاجية كرمات العنب وجودته من خلال إدارة التقليم واختيار عدد العيون المناسب، بما يحقق توازنًا بين الإنتاج الثمري، وكفاءة استخدام المياه، والنمو الخضري، وجودة العناقيد. يمكن أن يعزز التقليم ممارسات زراعية أكثر كفاءة واستدامة، مما يعزز كفاءة استخدام المياه، وإنتاجية الفاكهة وجودة كرمة العنب بلاك ماجيك.