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Influence of Cane Length and Number on Bud Behavior, Growth and Productivity of Black Magic Grapevines

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PRUNING is an essential process for grapevines and reaching the suitable level for each variety is of utmost importance in determining fruitfulness and quality. Therefore, the present study was carried out to study the effect of cane length on bud behavior, growth and productivity of Black Magic grape cultivar for two successive seasons (2021 & 2022) in a private vineyard located at Minia governorate, Egypt. The treatments comprised of four different levels of bud load as follows; 15 fruiting canes × 8 eyes/cane, 12 fruiting canes × 10 eyes/cane, 10 fruiting canes × 12 eyes/cane and 8 fruiting canes × 15 eyes/cane. The results showed that vegetative and reproductive growth were significantly affected by all different pruning levels of cane length and number in both seasons of this study. It was found that pruning at 12 fruiting canes × 10 eyes/cane attained a higher percentage of bud burst, coefficient of bud fertility, and yield compared with the other investigated treatments. However, shorter canes represented by 15 fruiting canes × 8 eyes/cane, reduced both cluster numbers and yield. Therefore, vines pruned with 12 fruiting canes × 10 eyes showed significantly the optimum results, as it achieved an appropriate balance between vegetative growth aspects, yield along with cluster quality.

Keywords: Black Magic Grapevines, Cane length, Bud behavior, Growth, Productivity.

Introducion

Black Magic is an early-maturing blue-black table grape, newly introduced in Egypt. The information concerning pruning for this cultivar under Egyptian environmental conditions is limited. It was created at the Institute of Viticulture in Chisinau, Moldova, by crossing Moldova x Marshal (origin V. labrusca) varieties under the name of "Codreanca". Afterwards, it took the name of "Black Magic" and it is internationally spread in many countries under this name (Pizzuto, 2013).

The haphazard application of some pruning systems has been the main reason for the undesired and unreliable results (Abbas et al., 2008). Pruning is considered an essential practice to improve grape production and quality (Fawzi et al., 2010). Pruning the vines for optimum cropping according to vigor is the most reliable method to maintain the balance between growth and production (Senthilkumar et al., 2015).

Therefore, adjusting the proper length of the fruiting units will undoubtedly affect the yield and bunch quality. In this respect, many researchers emphasized the importance of the pruning role in improving yield in terms of quality and quantity (Palma et al., 2000 and Gaser et al., 2017).

Using a suitable cane length should be beneficial and positively affect the quantity and quality of the fruit yield (Ali et al., 2000 and Terry & Rick 2003).

This investigation aimed to determine the appropriate cane length and number of Black Magic grapevines to attain a top quality crop.

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Materials and Methods

This study was conducted for two successive seasons (2021 & 2022) on Black Magic grapevines grown in a private vineyard located at Minia governorate to study the effect of cane length and number on bud behavior, growth and productivity. Six-year-old vines, grown in sandy soil, and it irrigated with a drip irrigation system were used in this investigation. Vines were spaced at 2 × 3 m apart, trellised via Spanish Parron system and pruned during the second week of January with a bud load of 120 buds/vine. Sixty uniform vines; four treatments in three replicates with five vines/for each replicate were chosen and pruned at the same cane number and length level for each treatment.

Four different levels of bud load were applied as follows; 15 fruiting canes × eight eyes, 12 fruiting canes × ten eyes, ten fruiting canes × twelve eyes, and eight fruiting canes × fifteen eyes buds per cane.

The following parameters were assessed along the growing season

Bud behavior

The bud behavior measurements were calculated according to Bessis (1960) as follow:

a. Percentage of bud burst was calculated by dividing the number of burst buds by the total number of buds left per vine and multiplying the product by 100.

b. The fruitful buds % was recorded by dividing the number of fruitful buds per vine (buds which gave at least one cluster) by the total number of burst buds and multiplying the product by 100.

c. Percentage of bud fertility was calculated by dividing the number of clusters/vine by the total number of buds and multiplying the product by 100.

Yield and its components

Fifteen clusters from each treatment were taken randomly when they reached their full color and TSS % from 16 to 17 %, according to Tourky et al. (1995) and the following parameters were determined:

Yield/vine (kg), average cluster weight (g), number of clusters/vine, average berry weight (g) and berry size (cm^3).

Berries chemical characteristics

The percentage of Total Soluble Solids (TSS%), TSS/acid ratio, total acidity % were determined according to A.O.A.C. (2000) and the total anthocyanin in the berry skin (mg/100g fresh weight) were determined according to Husia et al. (1965).

Vegetative growth parameters

Average shoots length (cm), number of leaves/shoot, leaf area (cm^2) taken from the apical 5^{th} to 6^{th} leaves were measured at the last week of June and coefficient of wood ripening was determined by taking 10 shoots from each replicate then calculate the rate of wood ripening by dividing the length of the ripened part by the total length of shoot according to Rizk and Rizk (1994).

Chemical analysis of the vegetative growth

Leaf pigments content (SPAD) according to Wood et al. (1992), total carbohydrates in canes (Smith et al., 1956).

Statistical analysis

The treatment combinations were assigned randomly to the experimental units within a block according to Snedecor and Cochran (1980) using a Randomized Complete Block Design (RCBD).

Results and Discussion

Bud behavior

Percentage of Bud burst, fruitfulness and bud fertility

Data in Table (1) revealed that bud behavior measurements expressed as bud burst (%), fruitful buds (%) and coefficient of bud fertility were significantly affected by different cane numbers and lengths in both seasons. Concerning the effect of cane number and length on the percentage of bud burst, it obvious that vines pruned at 12 fruiting canes × 10 eyes/cane significantly resulted in the highest percentage of bud burst followed by vines pruned at 10 fruiting canes × 12 eyes/cane with significant differences between them in both seasons. These results may be ascribed to that the first inflorescence appears in Black Magic at the third node according to Lush et al., (2012).

Concerning the effect of cane number/vine and cane length, on the percentage of fruitfulness and bud fertility, data obtained in Table (1) clearly show that, vines pruned at 12 fruiting canes × 10 eyes significantly resulted in the highest

TABLE 1. Effect of can length and number on bud behavior of Black Magic grapevines during the two successive seasons 2021 & 2022 .

Treatments (Cane length and number)	Bud burst (%)		Fruitful buds (%)		Bud fertility (%)	
	2021	2022	2021	2022	2021	2022
15 fruiting canes × 8 eyes	67.3	69.4	35.5	36.6	33.1	35.6
12 fruiting canes × 10 eyes	74.3	74.8	45.9	45.1	41.5	41.6
10 fruiting canes × 12 eyes	71.4	72.2	42.0	41.5	37.8	36.8
8 fruiting canes × 15 eyes	70. 9	71.5	39.8	41.2	37.2	37.9
New LSD (0.05)	2.0	1.9	3.0	3.1	2.9	2.8

percentage of those parameters. Our results are in harmony with those mentioned by Abbas et al. (2008), Khamis et al. (2008) and Gaser et al. (2017), who stated that vines with long pruning resulted in a higher percentage of bud fertility compared with short pruning.

Yield and its components

Results in Table (2) showed that yield, cluster weight, and number as well as berry weight and size were significantly affected by different cane lengths in both seasons. Concerning the effect of cane length on those parameters, data clears that vines pruned at cane length of 12 fruiting canes × ten eyes resulted in significantly the highest values, followed by vines pruned with 10 fruiting canes × 12 eyes, whereas 15 fruiting canes × 8 eyes induced the least value of these parameters in both seasons. These results coincided with Gaser et al., (2017), who revealed that vines with long pruning caused a significant reduction in cluster weight and dimensions in comparison with short pruning. Likewise, berry weight and size were affected positively by pruning the vines at 12 fruiting canes × 10 eyes than 15 fruiting canes × 8 eyes, were they induced the least values of those parameters in both seasons. Our findings are in harmony with those of Ghobrial, (2018) who declared that vines pruned with cane length of 6 buds resulted in significantly the highest values of these characteristics followed by vines pruned with cane length of 8 in Autumn Royal grape cultivar.

Berries chemical characteristics

Results in Table (3) showed the effects of number of fruiting canes and eyes on total soluble solids (TSS), TSS /acid ratio, total acidity and the total anthocyanin in the berry skin. It is obvious that the highest significant values of TSS, TSS/ acid ratio, and anthocyanin content of berry skin were attained from vines pruned at 12 fruiting canes × 10 eyes followed by 10 fruiting canes × 12 eyes whereas they recorded the least values of total acidity %. While the vines pruned at 15 fruiting canes × 8 eyes induced the least values in these parameters except for the total acidity which takes an opposite trend in both seasons. These

TABLE 2. Effect of cane length and number on yield and its components of Black Magic grapevines during the two successive seasons 2021 & 2022

Treatments (Cane length and number)	Yield / vine (Kg)		No. of clusters/ vine		Cluster weight (g))		Berry weight (g)		Berry size (cm^3)	
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
15 fruiting canes x 8 eyes	13.8	18.0	25.0	32.6	550.0	551.7	5.1	5.4	5.0	5.2
12 fruiting canes x 10 eyes	26.2	31.2	38.0	45.9	690.2	680.0	6.8	6.6	5.8	5.7
10 fruiting canes x 12 eyes	21.8	25.8	34.0	41.2	640.7	625.4	6.2	6.3	5.6	5.5
8 fruiting canes x 15 eyes	16.7	20.0	30.3	35.5	549.4	563.3	5.9	5.7	5.3	5.3
New LSD (0.05)	2.0	3.1	1.5	1.3	11.8	12.4	0.2	0.2	0.1	0.1

TABLE 3. Effect of cane length and number on yield and its components of Black Magic grapevines during the two successive seasons 2021 & 2022 .

Treatments (Cane length and number)	TSS (%)		Total acidity (%)		TSS / acid ratio		Anthocyanin (mg/100 g)	
	2021	2022	2021	2022	2021	2022	2021	2022
15 fruiting canes x 8 eyes	16.7	16.9	1.25	1.23	13.4	13.7	39.7	39.0
12 fruiting canes x 10 eyes	18.8	18.9	0.96	0.83	19.6	22.7	46.6	47.0
10 fruiting canes x 12 eyes	18.0	18.1	1.12	1.10	16.1	16.5	43.5	44.2
8 fruiting canes x 15 eyes	17.4	17.5	1.16	1.14	15.0	15.4	41.6	42.4
New LSD (0.05)	0.1	0.2	0.05	0.06	0.9	1.0	1.4	1.3

results are related to the findings of Abd El-Ghany (2006), Abbas et al. (2008) and Gaser et al. (2017), who cleared that vine with long pruning showed a significant decrease in juice TSS percentage, TSS/ acid ratio and anthocyanin content in berry skin, and an increase in total acidity % of the berry juice compared with short pruning.

Vegetative growth parameters

Results in Table (4) showed that vegetative growth aspects expressed as shoot length, the No. of leaves per shoot, leaf area/shoot, and coefficient of wood ripening was significantly affected by different cane lengths and numbers in both seasons. The highest values were obtained from the vines pruned at 12 fruiting canes × 10 eyes followed by 10 fruiting canes × 12 eyes then 8 fruiting canes × 15 eyes in both seasons. Whereas, the vines pruned at 15 fruiting canes × 8 eyes significantly induced the least values of these parameters respectively. Our results are in linear with those of Somkuwar et al., (2012) who mentioned that the increase in number of shoots per vine from 30 to 75 resulted into increase in yield per vine but reduced the vines highest shoot length, number of leaves/shoot and leaf area as compared to the other treatments. In other words, increasing the cane length decreased the current season's shoot length (Ghobrial, 2018)

Chemical analysis of the vegetative growth
Leaf pigments content (SPAD)

The chlorophyll amount/unit of leaf area is considered an indicator of the photosynthetic capacity of plants, (Taiz and Zeiger, 2004). The positive effect of adjusting a suitable cane length and number on leaf pigments content represented in total chlorophyll is displayed in Figure (1). It is obvious that vines with a medium numbers of canes at pruned at12 fruiting canes × 10 eyes induced the highest significant chlorophyll content followed by 10 fruiting canes × 12 eyes while the least values were shown in dense canopies pruned at 15 fruiting canes × 8 eyes. This result may be attributed to that Chlorophyll content decreased in the leaves of shaded plants, where chlorophyll concentrations in sun-exposed leaves were higher than ones in more shaded conditions (Gehan et al., 2020).

Total carbohydrates in canes (%)

The cane content of total carbohydrates percent is presented in Figure (2). A significant increase in the percentage of carbohydrates is noticed in the vines pruned with 12 fruiting canes × 10 eyes over the other levels of pruning. We can ascribe this increment to the effect of number of canes/vine on light intensity penetrating the canopy as moderate number of canes leads to increase the sunlight received by the leaves more than the higher number 15 fruiting canes × 8 eyes which induced the lower percentage of total carbohydrates. These findings were stated by (Gehan et al., 2020) who found that increase the sunlight received by the leaves inside the vines, leading to increase the process of photosynthesis and consequently increases the carbohydrate accumulation.

Conclusion

In conclusion, it can be noticed that moderate pruning at 12 fruiting canes x 12 eyes/ canes for Black Magic grape cultivar can be recommended for the optimum results concerning the percentages of bud burst, coefficient of bud fertility, yield/vine, berry qualities and vegetative growth characteristics.

TABLE 4. Effect of cane length and number on some vegetative growth parameters of Black Magic grapevines during the two successive seasons 2021 & 2022.

Treatments (Cane length and number)	Shoot length (cm)		No. of leaves / shoots		Leaf area (cm^2)		Coefficient of wood ripening	
	2021	2022	2021	2022	2021	2022	2021	2022
15 fruiting canes x 8 eyes	161.4	161.8	26. 7	26.0	152.3	156.0	0.80	0.81
12 fruiting canes x 10 eyes	189.8	189.2	32.6	31.9	180.5	179.8	0.92	0.93
10 fruiting canes x 12 eyes	179.3	180.9	29.8	29.8	169.7	168.4	0.88	0.85
8 fruiting canes x 15 eyes	170.2	169.5	28.4	27.5	160.9	162.3	0.83	0.82
New LSD (0.05)	5.5	5.8	1.2	1.4	4.3	3.9	0.02	0.01

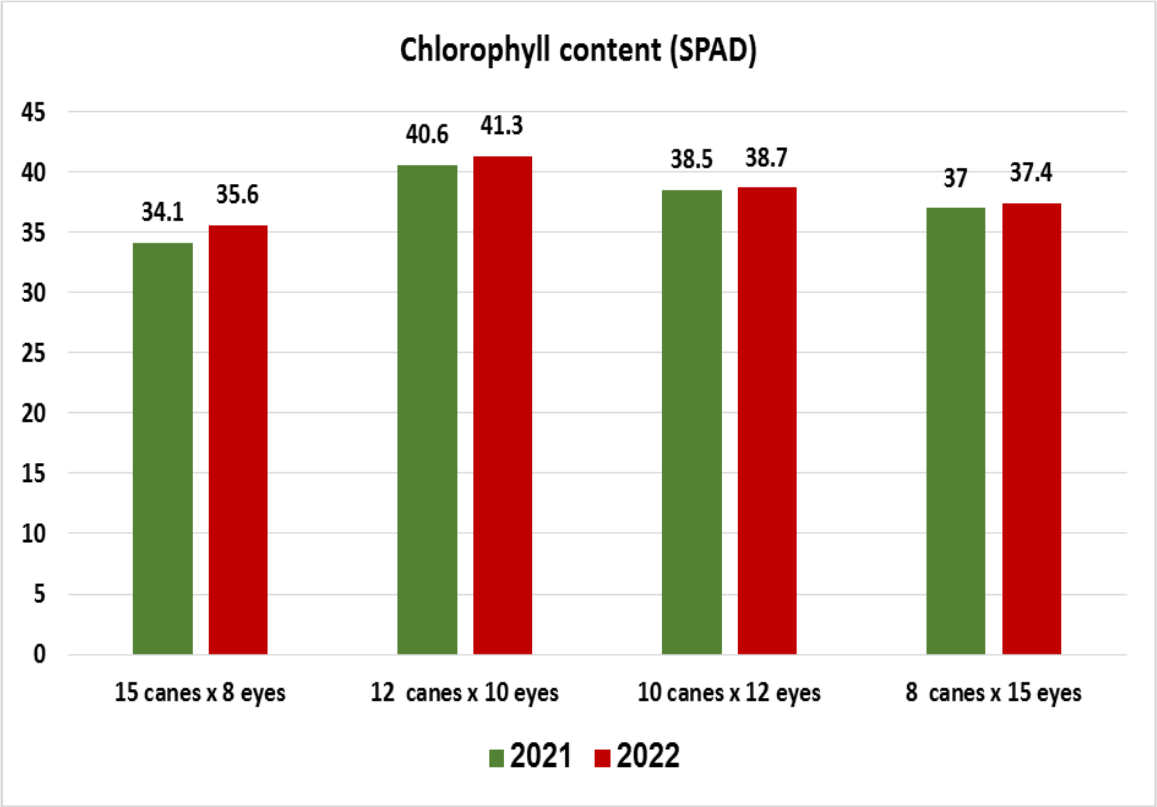

Fig. 1. Effect of cane length and number on leaf content of total chlorophyll of Black Magic grapevines during 2021 & 2022 seasons.

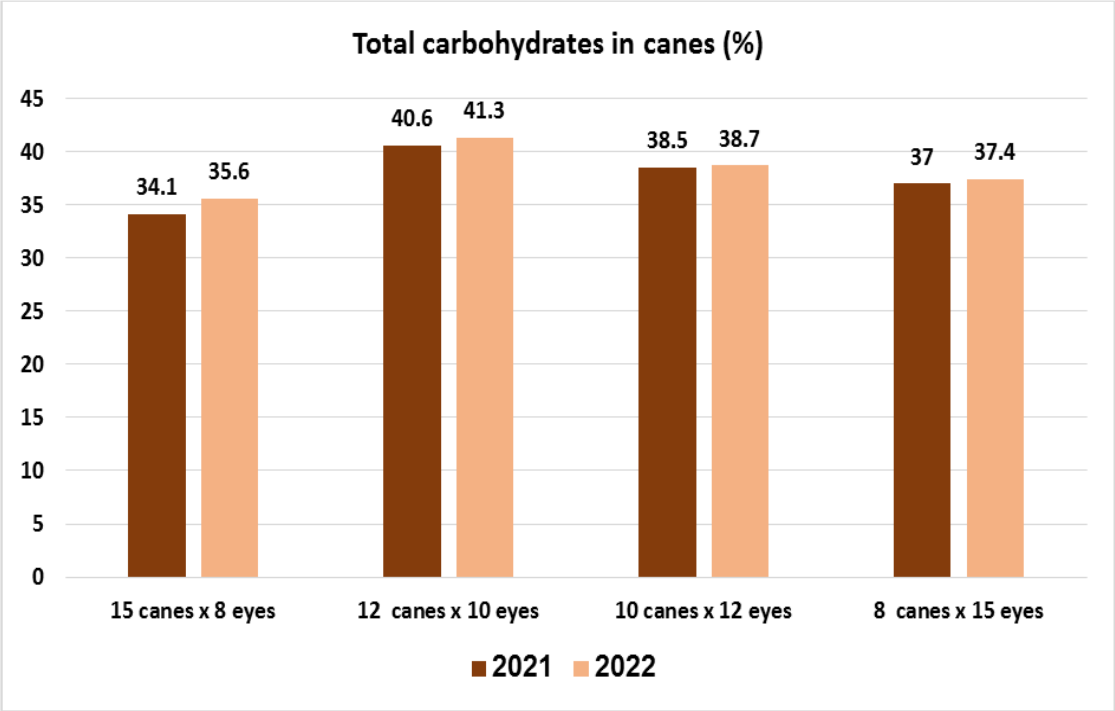

Fig. 2. Effect of cane length and number on cane content of total carbohydrates of Black Magic grapevines during 2021 & 2022 seasons.

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Conflicts of interest

The author declares that there is no conflict of interest regarding the publication of this study.

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تأثير طول وعدد القصبات علي سلوك العيون والنمو والانتاجية لكرمات العنب صنف البلاك ماجيك

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التقليم هو عملية أساسية لكرمات العنب والوصول إلى المستوى المناسب لكل صنف له أهمية قصوى في تحديد كمية الإثمار والجودة. لذلك أجريت هذه الدراسة لدراسة تأثير طول القصبات على سلوك العيون ونمو وإنتاجية صنف عنب بلاك ماجيك لموسمين متتاليين (٢٠٢١ و ٢٠٢٢) في مزرعة عنب خاصة بمحافظة المنيا. أشتملت المعاملات على أربعة مستويات مختلفة من حمولة البراعم على النحو التالي : ١٥ قصبة × ٨ عيون / قصبة ، ١٢ قصبة ثمرية × ١٠ عيون / قصبة ، ١٠ قصبات ثمرية × ١٢ عين / قصبة و ٨ قصبات ثمرية × ١٥ عين / قصبة. أظهرت النتائج تأثر النمو الخضري والثمري معنويا بكلا من طول وعدد القصبات في كلا الموسمين. وجد أن التقليم عند ١٢ قصبة ثمرية × ١٠ عيون / قصبة قد حقق نسبة أعلى من تفتح البراعم ومعامل خصوبة البراعم والمحصول مقارنة مع المعاملات الأخرى التي تمت دراستها. ومع ذلك ، فإن القصبات الأقصر ممثلة بـ ١٥ قصبة ثمرية × ٨ عيون / قصبة ، قللت من عدد ووزن العناقيد. لذلك فإن الكرمات التي تم تقليمها على ١٢ قصبة ثمرية × ١٠ عيون أظهرت النتائج المثلى بشكل ملحوظ حيث حققت التوازن المناسب بين خصائص النمو الخضري والمحصول وكذلك جودة العناقيد.