Impact of summer pruning on microclimate and quality attributes of Attika Seedless grape cultivar

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ABSTRACT

This study was performed in a vineyard located at Samalut district, El-Minia governorate, Egypt over the duration of two consecutive seasons (2023 and 2024) to study the effect of summer pruning practices on microclimate and quality attributes of Attika Seedless grapevines. The six-year-old vines planted 2*3m apart, grown in sandy soil, irrigated with the system of drip irrigation and supported by Spanish Parron trellising. In the first week of January, the vines were cane pruned at a load of eighty-four buds per vine. Eight summer pruning treatments were done, including defoliation and pinching the main shoots accompanied by three levels of lateral branches (maintaining laterals, topping laterals or removing laterals), which were applied either alone or in combination, in addition to the control treatment. At fruit set stage, pinching the main shoots was cutting 3-4 cm, and the lateral branches were topped up to 5-6 leaves, while the defoliation procedure was achieved by removing the leaves beneath the cluster at the veraison stage. The findings demonstrated that all summer pruning practices positively affect all quality attributes compared to untreated vines throughout two seasons. Pinching and topping laterals plus defoliation attained the best overall results by enhancing vine microclimate, which is reflected in improving vegetative growth aspects, elevating yield and enhancing berry quality traits of Attika Seedless grapevines.

Keywords: Grapes- Attika- Canopy- Microclimate- Yield.

INTRODUCTION

Attika grape cultivar is an early season, black seedless, with a large cluster and medium-sized berry which has recently been introduced to Egypt. It was released from Vassilis Mikos (Greece) as a result of the crossbreeding of Alphonse Lavalée and Black Monukka grape cultivars (Mattheou et al., 1995). This cultivar faces a main problem, namely the high density of vegetative growth, which negatively affects productivity and the quality of the clusters (Doloris et al., 2023).

Summer pruning is a supplementary procedure to winter pruning that comes before it and a prelude to the one that follows, which includes a series of administration practices that enable vine vigor control as well as balance vegetative growth with productivity by enhancing microclimatic status (Poni et al., 2018). Summer pruning is a demand practice that improves grape growth and quality features by increasing light and ventilation as well as lowering humidity and mold infection (Abd El-Wadoud, 2015, Ghobrial, 2018, Farag and Abd El-All, 2019, Candar et al., 2019 and Sabry et al., 2024).

By eliminating the shoot terminal as well as a few of the young leaves, shoot pinching has a particular place as a key component of operations the summer pruning. Its' primary goals are to control development and improve ventilation and light transmittance inside the canopy of vines, since this operation has been shown to raise the shoots' carbohydrate content, which improves fruit quality and yield (Poni et al., 2014 and Mohamed et al., 2023).

During the period between the stages of fruit set and veraison, one of the most crucial summer pruning procedures is

defoliation, also known as basal leaf removal around clusters (Bubola et al., 2017). Partial defoliation, according to some research, enhanced ripening and decreased the incidence of fungal infection by improving the canopy's microclimate and speeding up the movement of photosynthates from the residual leaves (Mucalo et al., 2021).

Therefore, the scope of the present investigation is to enhance yield and quality attributes of Attika Seedless grape cultivar via summer pruning practices.

MATERIALS AND METHODS

This study was performed in a vineyard located at Samalut district, El-Minia governorate, Egypt over the duration of two consecutive seasons (2023 and 2024) on seventy-two Attika Seedless grapevines uniform planted at 2*3m apart and supported by Spanish Parron trellising. The present investigation aimed to study the effect of summer pruning practices on microclimate and quality attributes of Attika Seedless grapevines. Six-year-old vines were grown in sandy soil and irrigated from the Nile River by drip irrigation system . In the first week of January, the vines were cane pruned (twelve canes * seven buds) with a load of eighty-four buds per vine. Each of the 3 vines represented as a replicate and each treatment constitutes of 3 replicates.

Eight summer pruning treatments were done as follows:

1. Control
2. Pinching the main shoots with maintaining laterals (PM)
3. Pinching the main shoots with topping laterals (PT)
4. Pinching the main shoots with removing laterals (PR)
5. Defoliation (D)
6. PM + D
7. PT + D
8. PR+ D

At fruit set stage, pinching the main shoots was cutting 3-4 cm, and the lateral branches were topped up to 5-6 leaves, while the defoliation procedure was achieved by removing the leaves beneath the cluster at the veraison stage.

Measured attributes:

1. Canopy Microclimate

After two weeks of veraison stage, canopy microclimate data including temperature (^oC), relative humidity (%) and light intensity (Lux) were monitored inside the vine canopies. Using Scheduler Plant Stress Monitor (Model R./O. Cons., Stan. Oil Engineered Materials Co., USA).

2. Vegetative growth aspects

After three weeks of veraison stage, five non-fruiting shoots/vine were selected. Average leaf area (cm^2) were measured for the 6-7 leaves from the shoot tip as mentioned by Montero et al. (2000). Furthermore, leaf content total chlorophyll (mg/g F.W.) was as by Mackinny (1941). At the first week of December, cane total carbohydrates content was measured and calculated as percentage as referred to by Smith et al. (1956).

3. Yield and physical attributes of cluster

As stated by Tourky et al. (1995), when TSS content in berry juice reached 16-17%, nine clusters were randomly harvested per vine. Yield per vine (kg), cluster weight (g), and dimensions (cm) were assessed.

4. Berry physical attributes

One hundred berries for each treatment were randomly taken and the following estimates were determined: The averages of berry weight (g), size (cm^3), and dimensions (cm).

5. Berry chemical attributes

As referred by A.O.A.C. (2005), the percentages of total soluble solids and acidity were assessed. TSS/acid ratio was calculated. In addition to, total anthocyanin (mg/100 g FW) as ascribed by Yildiz and Dikmen (1990).

Experimental design and statistical analysis:

For this trial, the randomized complete block was used Snedecor and Cochran (1980). As referred to Steel and Torrie (1980), at the 5% level, averages were compared by New L.S.D. values.

RESULTS AND DISCUSSION

1. Canopy microclimate:

All canopy microclimate parameters, such as light intensity, air temperature, and relative humidity were statistically influenced by the practices of summer pruning in comparison to the control throughout two seasons as demonstrated in **Table (1)**. Pinching and topping laterals plus defoliation significantly recorded the highest readings of light intensity and air temperature as well as the least values of relative humidity within the vine canopy. Conversely, the dense canopy of untreated vines statistically achieved the least readings of light intensity and air temperature as well as the highest readings of relative humidity. The affirmative influence of summer pruning on canopy vine's microclimate can be referred to the fact that it helps to enhance ventilation and sunlight penetration into the interior canopy, which leads to enhanced photosynthetic activity of the leaves, which in turn promotes the quality of the fruits (Omar, 2005, Farag and Abd El-All, 2019, Candar et al., 2019, Farag et al., 2020 and Sabry et al., 2024).

Table (1). Impact of summer pruning on canopy microclimate of Attika Seedless grapevines in 2023 and 2024 seasons.

Characteristics / Treatments	Light intensity (Lux)		Air temperature (°C)		Relative humidity (%)	
	2023	2024	2023	2024	2023	2024
Control (untreated vines)	37.14	38.87	29.85	30.06	72.79	73.67
Pinching the main shoots with maintaining laterals (PM)	40.02	41.91	31.78	33.41	69.73	71.55
Pinching the main shoots with topping laterals (PT)	47.79	49.92	33.58	35.24	61.66	64.67
Pinching the main shoots with removing laterals (PR)	42.88	44.89	32.21	33.86	67.08	69.84
Defoliation (D)	43.63	45.71	32.79	34.39	64.38	67.56
PM + D	48.20	50.42	34.34	36.02	58.25	61.24
PT + D	54.14	56.53	36.54	38.32	52.97	55.67
PR + D	53.89	56.32	35.08	36.77	55.62	58.49
New L.S.D. at 5 %	**0.23**	**0.19**	**1.45**	**1.51**	**2.63**	**2.74**

2. Vegetative growth aspects:

According to data displayed in **(Table 2),** all aspects of vegetative growth, including leaf area, leaf content of total chlorophylls as well as cane content of total carbohydrates were statistically influenced by the practices of summer pruning in comparison to the control throughout two seasons. The greatest significant readings for those aspects were observed in pinching and topping laterals plus defoliation, while the lowest values of these ones were evident in control vines.

The affirmative impact of summer pruning on vegetative growth aspects due to promotes the rate of sun radiation that the leaves in the inner canopy receive, which in turn enhances the leaves' photosynthetic activity and ultimately, the storage of carbohydrates (Omar, 2005). These findings are concurrent with those of Abd El-Wahab et al. (1997) and Abd El-Wadoud (2015), who disclosed that pinching the main shoots produced the maximum levels of total chlorophyll in the leaves and total carbohydrates in the canes.

Table (2). Impact of summer pruning on vegetative growth aspects of Attika Seedless grapevines in 2023 and 2024 seasons.

Characteristics / Treatments	Average leaf area (cm^2)		Leaf total chlorophyll content (mg/g F.W.)		Cane total carbohydrates content (%)	
	2023	2024	2023	2024	2023	2024
Control (untreated vines)	179.8	187.4	36.91	39.25	24.32	25.65
Pinching the main shoots with maintaining laterals (PM)	185.2	193.6	38.05	40.56	25.14	26.45
Pinching the main shoots with topping laterals (PT)	186.8	195.4	38.43	40.93	25.37	26.76
Pinching the main shoots with removing laterals (PR)	183.4	191.6	37.64	40.13	24.88	26.22
Defoliation (D)	182.3	190.8	37.47	39.97	24.78	26.10
PM + D	192.4	203.3	39.67	42.52	26.44	27.67
PT + D	195.9	206.4	39.89	42.86	26.69	28.04
PR + D	190.2	202.3	39.56	42.40	26.27	27.55
New L.S.D. at 5 %	**3.4**	**2.9**	**0.21**	**0.27**	**0.19**	**0.25**

3. Yield and physical attributes of cluster:

As compared to control vines during the two seasons, it's apparent from **(Table 3)** that all summer pruning practices exhibited a favorable impact on yield/vine and cluster attributes, including cluster weight, length, and width. The most significant values of those parameters were observed in pinching and topping laterals plus defoliation, whereas the least values of these traits were noted in control vines. The increment in yield and its attributes as a result of summer pruning may be due to the increase in photosynthates production which raises root density accompanied by a noticeable increase in the uptake of nutrients and the movement of more carbohydrates to clusters and hence increasing yield (Omar, 2005). These findings align with Abd El-Wadoud (2015), Ghobrial (2018), Farag and Abd El-All (2019), Candar et al. (2019) and Sabry et al. (2024) who stated that pinching the main branches achieved the highest cluster weight and yield. Regarding defoliation, Omar (2005) noted that, when compared with control, yield and its components were affirmatively impacted by leaf removal at the veraison stage.

Table (3). Impact of summer pruning on yield and cluster physical attributes of Attika Seedless grapevines in 2023 and 2024 seasons.

Characteristics / Treatments	Yield /vine (kg)		Average cluster weight (g)		Average cluster length (cm)		Average cluster width (cm)	
	2023	2024	2023	2024	2023	2024	2023	2024
Control (untreated vines)	14.47	15.07	434.2	452.1	24.27	24.33	16.99	17.06
Pinching the main shoots with maintaining laterals (PM)	15.43	16.51	461.4	489.5	24.48	24.48	17.24	17.35
Pinching the main shoots with topping laterals (PT)	15.58	16.82	467.5	495.7	24.55	24.52	17.33	17.42
Pinching the main shoots with removing laterals (PR)	15.08	15.84	448.2	470.9	24.42	24.42	17.21	17.25
Defoliation (D)	14.95	15.52	441.7	464.2	24.36	24.40	17.08	17.13
PM + D	16.72	18.13	495.6	526.9	24.73	24.67	17.59	17.81
PT + D	16.93	18.36	499.4	530.2	24.78	24.73	17.67	17.87
PR + D	16.67	18.09	495.2	526.4	24.67	24.65	17.52	17.65
New L.S.D. at 5 %	**0.17**	**0.13**	**3.7**	**3.1**	**0.04**	**0.03**	**0.06**	**0.03**

4. Berry physical attributes:

According to data displayed in **(Table 4),** all berry physical attributes, including berry weight, size, length and diameter were statistically influenced by the practices of summer pruning as comparison to the untreated vines in both seasons. The highest significant readings for those attributes evident in vines that had there shoots pinches and laterals topped plus defoliation, while the lowest values of these ones were observed in control vines. The large size of berries resulting from summer pruning is linked to photosynthesis activation within the canopy by enhancing penetration of light and temperature, which led to a raise in sugars in the berry and thus increasing their osmotic pressure and attracting more water, and hence elevated the size of the berries (Omar, 2005). These findings align with Abd El-Wadoud (2015), Ghobrial (2018), Farag and Abd El-All (2019), Candar et al. (2019) and Sabry et al. (2024) who stated that pinching the main branches achieved the highest berry physical characters. With respect to defoliation, Omar (2005) mentioned that, in comparison to control, berry weight and size were affirmatively impacted by leaf removal at the veraison stage.

Table (4). Impact of summer pruning on berry physical attributes of Attika Seedless grapevines in 2023 and 2024 seasons.

Characteristics / Treatments	Average berry weight (g)		Average berry size (cm^2)		Average berry length (cm)		Average berry diameter (cm)	
	2023	2024	2023	2024	2023	2024	2023	2024
Control (untreated vines)	4.54	4.61	4.16	4.28	2.54	2.61	1.79	1.82
Pinching the main shoots with maintaining laterals (PM)	4.66	4.77	4.25	4.35	2.60	2.67	1.83	1.87
Pinching the main shoots with topping laterals (PT)	4.69	4.79	4.27	4.36	2.64	2.69	1.87	1.89
Pinching the main shoots with removing laterals (PR)	4.61	4.69	4.22	4.31	2.59	2.65	1.83	1.86
Defoliation (D)	4.58	4.68	4.21	4.30	2.57	2.62	1.80	1.84
PM + D	4.79	4.88	4.33	4.42	2.75	2.80	1.94	1.97
PT + D	4.82	4.91	4.38	4.46	2.76	2.82	1.96	1.98
PR + D	4.77	4.87	4.32	4.41	2.72	2.78	1.93	1.95
New L.S.D. at 5 %	**0.03**	**0.02**	**0.04**	**0.03**	**0.02**	**0.01**	**0.02**	**0.01**

5. Berry chemical attributes:

In comparison with control vines during the two seasons, it's apparent from **(Table 5)** that all summer pruning practices displayed an affirmative effect on berry chemical attributes, such as TSS, total acidity and TSS/acid ratio as well as total anthocyanin. Pinching and topping laterals plus defoliation significantly recorded the highest magnitude of TSS, TSS/acid ratio as well as total anthocyanin and the least values of acidity. Conversely, the control vines statistically achieved the least magnitude of TSS, TSS/acid ratio as well as total anthocyanin and the highest values of acidity. According to Candolfi-Vasconcelos and Koblet (1994), the removal of shoot tips encourages the growth of lateral shoots, which in turn offers an added source of carbohydrates that aid in the ripening of the fruits by giving a largest surface for absorption of light to promote their growth and transfer the excessive to the main shoots. Furthermore, removing leaves at the veraison stage increases the amount of light that reaches the vine's canopy, which in turn activates the photosynthetic processes of the leaves within the canopy. Additionally, the removal of leaves allows air to circulate, which raises the temperature inside the canopy, which is reflected in increased TSS and decreased acidity (Omar, 2005). These findings align

with Abd El-Wadoud (2015), Ghobrial (2018), Farag and Abd El-All (2019), Candar et al. (2019) and Sabry et al. (2024) who stated that pinching the main branches achieved the most significant levels of TSS and anthocyanin in the berry skin, as well as the least amount of berry acidity. With respect to defoliation, Verdenal et al. (2019) and Mucalo et al. (2021) mentioned that leaf removal around the cluster at the veraison stage enhanced a significant elevate in fruit TSS and total anthocyanin.

Table (5). Impact of summer pruning on berry chemical attributes of Attika Seedless grapevines in 2023 and 2024 seasons.

Characteristics / Treatments	TSS (%)		Acidity (%)		TSS/acid ratio		Total anthocyanin (mg/100 g F.W.)	
	2023	**2024**	**2023**	**2024**	**2023**	**2024**	**2023**	**2024**
Control (untreated vines)	16.29	16.56	0.65	0.63	25.06	26.29	40.69	42.48
Pinching the main shoots with maintaining laterals (PM)	16.71	17.19	0.63	0.60	26.52	28.65	42.50	44.49
Pinching the main shoots with topping laterals (PT)	16.79	17.34	0.62	0.59	27.08	29.39	42.73	44.74
Pinching the main shoots with removing laterals (PR)	16.69	17.01	0.63	0.61	26.49	27.88	42.40	44.38
Defoliation (D)	16.37	16.63	0.64	0.61	25.58	27.26	41.95	43.91
PM + D	16.89	17.51	0.60	0.57	28.15	30.72	43.19	45.24
PT + D	17.01	17.64	0.59	0.55	28.83	32.07	43.72	45.83
PR + D	16.84	17.48	0.61	0.58	27.61	30.14	43.01	45.01
New L.S.D. at 5 %	**0.11**	**0.08**	**0.01**	**0.02**	**0.67**	**0.53**	**0.51**	**0.47**

CONCLUSION

Based on the outcomes that were obtained, it could be inferred that pinching and topping laterals plus defoliation attained the best results by increasing solar radiation absorbed by the leaves in the inner canopy, that is reflected in improving vegetative growth aspects, elevating yield and enhancing berry quality traits of Attika Seedless grapevines.

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الملخص العربي

تأثير التقليم الصيفي على المناخ الدقيق وصفات الجودة لصنف العنب الأتيكا سيدلس

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قسم بحوث العنب- معهد بحوث البساتين – مركز البحوث الزراعية – الجيزة

أجريت هذه الدراسة في مزرعة عنب تقع في منطقة سمالوط، التابعة لمحافظة المنيا، مصر، خلال موسمين متتاليين (2023 و 2024) لدراسة تأثير معاملات التقليم الصيفي على المناخ الدقيق وخصائص الجودة لصنف العنب الأتيكا سيدلس. تم زراعة الكرمات التي يبلغ عمرها ست سنوات على مسافة 2 × 3 متر، ونامية في تربة رملية، ومروية بنظام الري بالتنقيط ومرباة تحت نظام التكاعيب الإسبانية. في الأسبوع الأول من شهر يناير، تمّ تقليم الكرمات تقليما قصبيًا مع الحفاظ على حمولة 84 عين/كرمة. تم إجراء ثماني عمليات تقليم صيفي: التوريق، تطويش الأفرع الرئيسية مصحوبة بثلاثة مستويات من الأفرع الثانوية (الحفاظ على الأفرع الثانوية أو قصف الأفرع الثانوية أو إزالة الأفرع الثانوية)، والتي تم تطبيقها إما بصورة منفردة أو بالاشتراك مع بعضهما البعض، بالإضافة إلى معاملة الكنترول. عند مرحلة عقد الثمار، تم تطويش الأفرع الرئيسية عن طريق إزالة 3-4 سم من قمة الفرع في حين تم قصف الأفرع الثانوية إلى 5-6 أوراق ، بينما تم إجراء عملية التوريق عن طريق إزالة الأوراق الموجودة أسفل العنقود في مرحلة بداية التلوين. أشارت النتائج أن جميع معاملات التقليم الصيفي أثرت بشكل إيجابي على جميع صفات الجودة مقارنة بمعاملة الكنترول طوال الموسمين. كما حققت معاملة تطويش الأفرع الرئيسية مع قصف الأفرع الثانوية + التوريق أفضل النتائج من خلال تحسين المناخ الدقيق داخل الكرمات، مما انعكس ذلك فى تحسين صفات النمو الخضري ، وزيادة المحصول وتحسين صفات الجودة لصنف العنب الأتيكا سيدلس.