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Employing Leaf Removal and Spraying Gibberellic Acid (GA_3) to Reduce Cluster Compactness Coefficient and Enhance Chemical and Physical Properties of Thompson seedless H_4 Grapevines.

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ABSATRACT

This investigation was carried out in the vineyard of the EL-Baramon experimental farm over two seasons (2021 and 2022). Horticultural Research Institute, Mansoura, Dakahlia Governorate, Egypt. The experiment was carried out on seven-year-old Thompson seedless grapevines (H4 strain). The vines were planted in clay soil using surface irrigation system, cane pruning, and trellising using the Spanish Baron technique. The purpose of this research was to decrease the compactness coefficient of clusters and improve the physical and chemical quality of clusters and berries in Thompson seedless grapes (H_4 strain). A field experiment was conducted in a randomized complete design with four times of leaf removal individual or in combination with GA_3, which applied by removing 6 leaves at the beginning of flowering, 25% of flowering, 50% of flowering and at 75% of flowering to compare the effect of these treatments on the performance of Thompson seedless grapevines (H_4 strain) during 2021 and 2022 seasons. Results revealed that removing 6 leaves at the 75% of flowering + spraying GA_3 at 10 ppm was the best in enhancing vegetative growth, total nitrogen in canes, carbohydrate contents in canes, yield and physical properties of cluster and berries, whereas the same treatments decreased the compactness coefficient, Botrytis incidence and Botrytis severity of the clusters. It can be concluded that removing 6 leaves at the 75% of flowering + spraying GA_3 at 10 ppm lead to improve chemical and physical properties and reduce compactness coefficient of Thompson seedless grapevines (H4 strain).

Keywords: Thompson Seedless 'H4 strain'; Leaf Removal ; Gibberellic Acid (GA3).

INTRODUCTION

The Thompson seedless grape is Egypt's most widely grown table grape, utilized for sultana production, domestic use, and export. In lately, the H_4 variety has gained special position especially for table grapes and raisins due to of its outstanding productivity (Dry *et al.*, 2022). This variety, nevertheless, develops clusters that are excessively compact and little berries. (Elatafi *et al.*, 2022), negatively impacting market quality. Addressing these issues could significantly improve market prices for both local consumption and export. The H4 strain's fast proliferation in recent years has been linked because of its high yield and its heavy clusters clusters. Overcoming the compactness and small berry size is crucial to improve market value. Consumer preferences for grape looks and quality for eating focus on berry and cluster size, form, color, compactness, wrapping, sugar-to-acid balance, and the absence of defects like decay, stem browning, and soft berries (Sonnekus, 2015).

Bunch compactness, a crucial grapevine trait, impacts susceptibility to pathogens and ultimately fruit quality (Molitor *et al.*, 2015). Tighter clusters create microclimates favoring fungal growth due to increased humidity between berries. Additionally, berry-to-berry pressure can lead to juice leakage from cracked berries (Tello and Ibáñez, 2018). Poor grape hygiene further compounds the problem, often necessitating early harvest and a decline in overall quality. In red grapes, for example, fungal laccase activity (like that of *Botrytis cinerea*) can cause color loss and reduced antioxidant activity (Steel *et al.*, 2013). Finally, compact bunches expose berries to uneven sunlight, resulting in inconsistent ripening within the cluster. Bunch compactness is affected by three factors: the total number of berries per bunch, the dimension of the berries, and the overall length of the rachis and pedicel. (Tello *et al.*, 2015). Fortunately, various strategies can be employed to influence these factors, such as the application of gibberellic acid (GA_3), leaf removal, shoot trimming, rootstock selection, and canopy shading (Basile *et al.*, 2015).

Gibberellic acid (GA_3), a type of plant growth regulator (PGR), plays a crucial role in grapevine growth and development, particularly by influencing cell division and enlargement during berry formation Molitor et al. (2012b). It is the most often utilized PGR in table grape cultivation for three main purposes: 1) increasing rachis length (the stem of the bunch) to loosen clusters, 2) thinning berries to improve compactness by reducing fruit set, and 3) enlarging berries to meet specific market demands Roubelakis-Angelakis (2009). The effectiveness of each application depends on both the grapevine's developmental stage and the applied GA_3 concentration, which vary significantly between grape varieties. In the table grape industry, GA_3 is a popular tool for thinning clusters, reducing berry set (Özer *et al.*, 2012), and increasing berry size. This is especially valuable for seedless varieties, which produce tight clusters containing little berries. The "stretching" effect that GA_3 has on bunches also helps loosen tight clusters, potentially reducing bunch rot Hed *et al.* (2011).

Basal defoliation, removing leaves around the grape clusters, is a common technique for managing grapevine

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canopies. The timing and intensity of leaf removal significantly impact fruit development and vary depending on grape variety and climate. For high-yielding cultivars, basal defoliation performed just before flowering (anthesis) can regulate yield by reducing fruit set percentage. This is because removing leaves creates a temporary carbon limitation, affecting flower development (Sabbatini and Howell, 2010; Frioni *et al*., 2019). However, in warm climates, this summer pruning technique can be detrimental to berry composition due to excessive sun exposure on the bunches Spayd *et al.* (2002). Several cultural practices can improve bunch compactness, including basal defoliation, tipping/topping (shoot pruning), bunch shortening (before or during flowering), and pre-bloom or full-bloom leaf removal (SATI, 2019; Abd El-Khalek *et al*., 2023). Leaf removal during these periods impacts flower development. Reduced leaf photosynthesis lowers the amount of sugars available for developing flower clusters, leading to flower drop and ultimately a decrease in berries per bunch (Vaillant-Gaveau *et al*., 2011; Tello and Ibáñez, 2018).

This investigation aims to evaluate the effect of exogenously applied gibberellic acid (GA_3), either alone or in combination with leaf removal at bloom, on reducing cluster compactness coefficient, decreasing pathogens susceptibility, and increasing qualitative characteristics of Thompson seedless H_4 grapes grafted onto Freedom rootstock.

MATERIALS AND METHODS

1. Plant Material, Vineyard Site and Treatments:

This investigation was conducted over two consecutive seasons (2021 and 2022) in the vineyard of the EL-Baramon Experimental Farm, Hort. Res. Inst., Agric. Res. Center, El-Baramon, Mansoura, Dakahlia, Egypt. The study was carried out on 7-years-old Thompson seedless H_4 grapevines grafted on Freedom rootstock.

The vines were planted in clay soil, using a surface watering system. Vines were planted with a spacing of 2 x 3 meters, utilizing cane pruning during the last week of January. This involved leaving 8 canes, each with 12 eyes, along with 8 spurs, resulting in a total bud load of about 112 eyes per vine. Grapevines were trained utilizing Spanish Paron trellis and a quadrilateral cordon training technique with long canes. The crop load for treatments is set at twenty-five clusters / vine.

In this study, ninety grapevines were chosen to be as uniform in vigor as possible. All grapevines were subjected to the same cultural management practices recommended by the Ministry of Agriculture and Land Reclamation, such as fertilization, irrigation, disease management, and pest management. The experiment formed of ten treatments distributed in a completely random block design. Each treatment was repeated three times, with each replicate including three vines. The same vines were used during both seasons of the study. The treatments were as follows:

1- Control (spraying tap water).
2- Removing 6 leaves at the beginning of flowering.
3- Removing 6 leaves at 25% of flowering.
4- Removing 6 leaves at 50% of flowering.
5- Removing 6 leaves at 75% of flowering.
6- Spraying GA_3 at 10 ppm on flowering.
7- Removing 6 leaves at beginning of flowering + Spraying GA_3 at 10 ppm.
8- Removing 6 leaves at 25% of flowering + Spraying GA_3 at 10 ppm.
9- Removing 6 leaves at 50% of flowering + Spraying GA_3 at 10 ppm.
10- Removing 6 leaves at 75% of flowering + Spraying GA_3 at 10 ppm.

Basal defoliation included removing the initial six leaves at the shoot bottom, at four stages: 0, 25, 50, 75 % of the bloom stage alone or with GA_3 at 10 ppm. and the individual treatment of GA_3 at 10 ppm was employed on 75% of bloom stage. The used Gibberellic acid was Berelex ™ (containing 10% gibberellic acid) produced by Valent Biosciences Co., USA. Furthermore, GA_3 was carried out on Thompson seedless H_4 grapevines as traditional vineyard treatment prior to bloom, at a rate of 15 ppm, for enhanced cluster elongation, until the clusters reached a length of around 10 cm. Foliar application of distilled water and GA_3, mixed with Tween 20 (0.1%) as a surfactant, was applied using a power sprayer, Model HT-767 (Taizhou Tianyi Agricultural and Forestry Machinery Co., Zhejiang, China). The treatments were administered between 6:00 and 8:00 a.m.

The seasonal phenology exhibited a similar pattern in the 2020/2021 & 2021/2022 seasons, with bud break, bloom, véraison and harvest occurring no more than of five days of each other, as depicted in Table 1.

Table 1. Phenological stages for the 2020/2021 & 2021/2022 seasons.

Phenological stage		2020/2021	2021/2022
Bud burst		15- March	17- March
Bloom	0%	01-May	03-May
	25%	05-May	06-May
	50%	08-May	10-May
	75%	12-May	15-May
Véraison		18-June	22-June
Harvest		01- August	05- August

2.The recorded measurements during the two experimental seasons:

Vegetative growth:

Vegetative growth parameters have been measured from non-bearing branches to estimate the average shoot diameter and length (in cm) after berry set. The average leaf surface area (cm^2) was estimated using the technique outlined in (Montero *et al.*, 2000) Leaf area (cm^2 / leaf) = 0.587 (L × W), where, L= Length of leaf blade. W= Width of leaf blade

and total leaf area per vine (m^2) is obtained via multiplying average leaf surface area by the average number of leaves per shoot by the number of shoots / vine. Moreover, chlorophyll content in leaves was conducted according to the protocol of (Lichtenthaler and Wellburn, 1985) The absorbance of the extract was measured at 663 nm for chlorophyll 'a' and 646 nm for chlorophyll 'b' using a UV/Vis spectrophotometer, Model UV-9100-B (LabTech Inc., Hopkinton, MA, USA), and chlorophyll contents (µg/ml) were calculated using the following equations:

Chlorophyll a = (12.21 E663 - 2.81 E646)

Chlorophyll b = (20.13 E646 - 5.03 E663)

Where E is the optical density at the indicated wave length.

Accordingly, total chlorophyll content (mg/g fw) was calculated, as follow:

Total chlorophyll = [((chlorophyll a + chlorophyll b) × extract volume)/(1000×fw)]. The microkieldahl technique was used to determine the total nitrogen content of canes (N), As stated by (Cottenie et al., 1982) and carbohydrate content in canes (C) (four non-fruiting shoots from the newly formed spurs; two shoots on every side of the vine) were taken at random towards on ending of growth season at the late of December to assess total carbohydrates, following the procedure illustrated by (Hodge and Hofreiter, 1962) for estimating C/N ratio.

Yield

When the soluble solid content (SSC) reached 16–17 °Brix all clusters were harvested. The soluble solid contents was determined using A hand-held refractometer (0-32%), Model N-1E (Atago Co., Ltd., Tokyo, Japan). A conventional field digital scale with a 200 kg capacity was used to weigh twenty-five clusters of every vine in a replicate (VEVOR Equipment and Tools, Rancho Cucamonga, CA, USA). The average yield per vine for each treatment was determined by multiplying the cluster weight by the number of clusters per vine (kg/vine).

Physical properties of cluster and berries

At harvest, ten clusters / vine were chosen at random, and separately weighed on a bench-top digital scale (Model PC-500 Doran scales, Batavia, IL, USA). We estimated then reported the average cluster weight (g). Cluster length and width (cm) were determined from the top most berry to the lowest berry using a standard 40-cm stainless steel ruler (Apuxon, Shenzhen, Guangdong, China). The mean of 100 berry weight (g), berry length and berry diameter (cm) and shape index of berry were also determined, as well as average berry weight (g) and berry size (mm) were also estimated.

The number of berries on clusters was recorded. The cluster compactness coefficient determined using the following method, according to (Fawzi et al., 2019).

Compactness coefficient of cluster = number of berries / cluster length.

Referring to Botrytis incidence, after harvest it was determined as a percentage between the number of incidence clusters with rot and clusters number per vine. Botrytis severity was assessed as a percentage between the number of diseased berries and berries number per cluster, following method described by (Shalan and Hamza, 2020).

Chemical Characteristics of berries:

- Soluble solids content of Juice (SSC %): Twenty berries were utilized to evaluate SSC (°Brix) utilizing a hand-held refractometer 0-32 %, Model N-1E (Atago Co., Ltd., Tokyo, Japan).

- Total acidity: calculated by a percentage of tartaric acid ($C_4H_6O_6$) in 10 ml juice using NaOH (0.1 N), and phenolphthalein as indicator, then SSC/acid ratio were calculated

- Total sugars (%): determined using method described on (Sadasivam and Manickam, 1996), the absorbance at 490 nm was recorded with a spectrophotometer and the total sugar content was estimated as grammes of glucose per 100 grammes of fresh weight (g glucose/100 g/FW) and reported as a percentage.

- Total carotenoids in the skin of berries (mg/g F.W.): estimated to the method outlined by (Mackinney, 1941).

Pruning weight (kg)

pruning weight were measured directly after pruning and expressed as (Kg/vine)

Coefficient of wood ripening

Five ripe canes samples were gathered in the first week of November. Wood ripening coefficient was computed by dividing the length of the ripened part of the cane cm (which changes from greenish to brownish colour) on the total length of the cane using the procedures outlined by (Bouard, 1966).

3. Statistical analysis

Statistics from the study's two seasons were statistically analyzed using variance analysis (ANOVA) as defined (Snedecor and Cochran, 1994), by the statistical software program SAS (SAS Institute Inc. Cary, NC, USA) with randomized complete design. All treatment were replicated three times. the New Least Significant differences Test (LSD) at a 5% probability level was preformed to compare between means, following the guidelines described by (Waller and Duncan, 1969).

RESULTS AND DISSCUSION

1- Vegetative growth characteristics (shoot length, shoot diameter and leaf area):

Vegetative growth parameters including shoot length shoot diameter and leaf area which serve as indexes of vine vigor for Thomson seedless H_4 grapevines as shows in Table 2. All treatments involving leaf removal at the flowering and application of GA_3 significantly affected shoot length, shoot diameter and leaf area in comparison to the control in two seasons. Specifically, the leaf removal at 75% of flowering treatment alone (T5) produced the greatest values on vegetative growth parameters as compared to other individual leaf removal treatments in both seasons of this study. Furthermore, vines treated with GA_3 at 10 ppm (T6) exhibited a more pronounced effect than the leaf removal treatments alone. The data also clear that the treatment combination of GA_3 application combined with leaf removal at 75% of flowering (T10) presented the highest values of shoot length (147.67 & 152.67cm), shoot diameter (1.20 & 1.21 cm) and leaf area (129.67 & 132.67cm^2) compared to other treatments. In contrast, the control treatment (T1) yielded the fewest values recording (129.33 & 134.67 cm) for shoot length, (0.92 & 0.79 cm) for shoot diameter and (102 & 105 cm^2) for leaf area in the 2021 and 2022 seasons respectively.

The role of gibberellic acid (GA) in grapevines, particularly GA_3 regulates growth and development in grapevines via cell division and cell enlargement throughout the onset phases of berry development (Cahoon et al., 1986; Dokoozlian, 2000; Ungsa et al., 2003; Roubelakis-Angelakis, 2009; Molitor et al., 2012b). GA3 is frequently defined as a signaling molecule that controls plant growth and development in conjunction with environmental elements that influence plant growth and development (Korkutal *et al.*, 2008; Roubelakis-Angelakis, 2009; Rademacher, 2015).

Gibberellic acid stimulates cell division and expansion, raises protein biosynthesis, promotes the development of new tissues, and improves water and nutrient absorption. These effects are shown in the improvement of vegetative growth characteristics. GA_3 is a successful strategy for increasing Black Magic grape cultivar berries and may be used in a wide variety of orchards (Abu-Zahra and Salameh, 2012).

The results in this respect were in accordance with those of Mohsen and Ali (2019), who indicated that spraying 'Red Globe' grapevines with GA_3 at 1 ppm at 80% bloom increased leaf area shoot length, compared to the other treatments. And Noori *et al.* (2018) found that gibberellin acid is crucial for enhancing vegetative growth, cell elongation, activating the plant's vital processes, and raising leaf area.

Shalan and Hamza (2020) demonstrated that Crimson grapevines were defoliated before and after flowering by removing eight basal leaves, and these treatments resulted to improved vegetative growth conditions and less rot infections. The improved shoot length and leaf area acquired by the application of basal defoliation treatments increased light penetration into the vine, therefore improving photosynthetic activity and carbohydrate buildup on Crimson seedless grapevines. (Abd El-Khalek *et al.*, 2023)

Table 2. Effect of leaf removal and GA_3 on shoot length shoot diameter and leaf area of Thompson seedless 'H4 strain' grapevines during both seasons.

Characteristics		Shoot length (cm)		Shoot diameter (cm)		Leaf area (cm^2)	
Treatments		2021	2022	2021	2022	2021	2022
1	Control	129.33	134.67	0.92	0.97	102	105
2	Removing 6 leaves at the beginning of flowering	131.33	136	0.94	0.99	104	107
3	Removing 6 leaves at the 25% of flowering	132.67	138.33	0.95	1.02	105.33	108.33
4	Removing 6 leaves at the 50% of flowering	134.33	142	0.98	1.02	107.67	110.33
5	Removing 6 leaves at the 75% of flowering	135	142.67	1.00	1.04	110	111.67
6	Spraying GA_3 at 10 ppm	137	144	1.01	1.06	112	115.67
7	Removing 6 leaves at the beginning of flowering+ spraying GA_3 at 10 ppm	141	147.33	1.06	1.11	117	121
8	Removing 6 leaves from at the 25% of flowering+ spraying GA_3 at 10 ppm	143.33	148.33	1.08	1.12	118.67	123.67
9	Removing 6 leaves at the 50% of flowering+ spraying GA_3 at 10 ppm	146	150.67	1.11	1.13	120.67	126.67
10	Removing 6 leaves at the 75% of flowering+ spraying GA_3 at 10 ppm	147.67	152.67	1.20	1.21	129.67	123.67
New L.S.D at 5%		2.02	2.49	0.03	0.03	2.78	3.25

2- Yield per vine and per feddan:

Table 3 shows that all treatments employed in this study lowered average yield per vine and yield per feddan when compared to the control during both seasons. Additionally, the data show a non-significant difference between the application of leaf removal at flowering, GA_3 and its combinations compared to untreated vines with respect to yield per vine and yield per feddan in the first and second season of study. The reduction in yield could be attributable to the application of GA_3 at bloom stage, which reduced berry set and increased blossom falling, resulting in a reduction in both number of cluster berries and cluster weight as shown in Table 3. A drop in yield per vine and per feddan caused by fruit thinning with observed by Knezović *et al.* (2009). These results are consistent with those of other research professionals, similar to (Dokoozlian and Peacock, 2001; El-Akkad, 2004; Ahmed, 2007; Selim, 2007). Their discovered the spraying vines using GA3 at full bloom in several grapevine varieties resulted in decent thinning impact and a lower berry set percentage than the control. Early blooming GA treatment was observed in some varieties to produce significant crop yield loss (Hed *et al.*, 2015). Additionally, Wegher et al. (2022) applied GA at 20 mg L^{-1} and found that it lowered yield / vine and fruit set to comparable extent to leaf removal (LA). Leaf removal during these periods impacts full-flowering as reduced leaf photosynthesis led on fewer photo assimilates accessible to growing inflorescences. This increases blossom drop, lowering the amount of berries per bunch (Lebon *et al.*, 2008; Vaillant-Gaveau *et al.*, 2011; Tello and Ibáñez, 2018) and (Abd El-Khalek *et al.*, 2023).

Table 3. Effect of leaf removal and GA3 on Yield / vine and Yield / feddan of Thompson seedless Sultana 'H4 strain' grapevines during both seasons

Characteristics		Yield / vine (Kg)		Yield/ feddan(Ton)	
Treatments		2021	2022	2021	2022
1	Control	16.37	17.07	11.46	11.95
2	Removing 6 leaves at the beginning of flowering	15.92	16.62	11.15	11.64
3	Removing 6 leaves at the 25% of flowering	15.83	16.54	11.08	11.57
4	Removing 6 leaves at the 50% of flowering	15.84	16.6	11.08	11.62
5	Removing 6 leaves at the 75% of flowering	15.31	16.08	10.72	11.26
6	Spraying GA_3 at 10 ppm	15.61	16.40	10.93	11.48
7	Removing 6 leaves at the beginning of flowering+ spraying GA_3 at 10 ppm	15.41	16.24	10.79	11.37
8	Removing 6 leaves from at the 25% of flowering+ spraying GA_3 at 10 ppm	15.44	16.26	10.81	11.38
9	Removing 6 leaves at the 50% of flowering+ spraying GA_3 at 10 ppm	15.18	15.97	10.62	11.18
10	Removing 6 leaves at the 75% of flowering+ spraying GA_3 at 10 ppm	15.11	15.89	10.58	11.12
New L.S.D at 5%		0.97	0.98	0.68	0.68

3- Physical characteristics in cluster:

Data presented in Table 4 show the effect of leaf removal and GA_3 application at flowering, as well as their combination on cluster weight, cluster length and cluster width. Table 4 shows that all treatments considerably lowered average bunch weight relative to the control over both seasons of research. In addition, results indicated the highest values of cluster length (29 & 32 cm) were acquired from the vines sprayed with GA_3 at 10 ppm + leaf removal at 75% of flowering (T10), while the shortest cluster length (22 & 24 cm) resulted from control vines (T1). Similarly, the data suggests that cluster width followed the same trend as cluster length; since the highest cluster width (17 and 18 cm) was recorded with GA3 at 10ppm + leaf removal at 75% of flowering (T10), the lowest cluster width (12.33 and 13.33) resulted from control vines (T1) in both seasons of study.

Gibberellic acid (GA3)'s effects on cluster weight reduction may be related to its capacity to improve cell division and expansion, in addition boost protein biosynthesis and encourage the development of new tissues. These activities promote water and nutrient absorption, resulting in increased vegetative growth and shifting the rivalry between flower clusters and vegetative parts favors of the latter. Therefore, some blossoms may fall, resulting in reduced cluster weight (Belal, 2019). Similarly, The positive benefits of Gibberellic acid (GA_3) on cluster length and cluster width may stem from its ability to increase cell division and cell enlargement, elevate the biosynthesis of proteins and promote the production of new tissues. This enhancement in water and nutrient uptake is reflected in a boost in cluster length and width (Dimovska *et al.*, 2011; Abu-Zahra and Salameh, 2012; Dimovska *et al.*, 2014; Abada *et al.*, 2015). These findings are consistent with those of Khalil (2020) on Flame seedless grapevines, who concluded that GA_3 sprayed twice produced an improvement in cluster length and decrease berries number / cluster, reflecting reduction in compactness. Similar results were also reported by Dokoozlian and Peacock (2001), who applied GA_3 on ‘Crimson seedless’ grapevines at 80% bloom stage. GA_3 spraying during full bloom drastically decreased the number of berries, while bunch length remained unaffected (Khalil *et al.*, 2023). The length of rachis on 'Cabernet Franc' and 'Cabernet sauvignon' grapes increased since GA_3 concentrations were 50 and 100mg/L, respectively (Gao *et al.*, 2020). Additionally, lowering in the berries number resulted in a reduced weight of bunch for 'Sultanina-C'. To Limit the availability of nutrients during blooming, remove leaves from the bunch zone, resulting in a nutritional shortfall for the process of flowering. Consequently, this leads to marked blossom thinning, resulting in reduced berries set, fewer berries and lower bunch weight (Intrieri *et al.*, 2008; Tardáguila *et al.*, 2008; Molitor *et al.*, 2011).

Abd El-Khalek *et al.* (2023) clarify that their findings are consistent with the current study and contradict prior reports on 'crimson seedless' grapes. Previous studies shows defoliation before the blooming stage improved weight of cluster, size of cluster, and also weight of berry and size of berry (Abdel-Razek *et al.*, 2010; Tardaguila *et al.*, 2010).

Table 4. Effect of leaf removal and GA_3 on cluster weight, cluster length and cluster width of Thompson seedless Sultana ‘H_4 strain’ grapevines during both seasons.

Characteristics	Cluster weight		Cluster length		Cluster width	
Treatments	2021	2022	2021	2022	2021	2022
1 Control	654.6	682.6	22	24	12.3	13.3
2 Removing 6 leaves at the beginning of flowering	636.6	664.6	23	25	13.67	14.6
3 Removing 6 leaves at the 25% of flowering	633.3	661.3	23	24.6	14	15
4 Removing 6 leaves at the 50% of flowering	633.3	664	24	25	15	16.3
5 Removing 6 leaves at the 75% of flowering	612.3	643.3	24.6	25.6	15	16.3
6 Spraying GA_3 at 10 ppm	624.3	656	26	27	15	16.6
7 Removing 6 leaves at the beginning of flowering+ spraying GA_3 at 10 ppm	616.3	649.3	26.6	28.6	15	17
8 Removing 6 leaves from at the 25% of flowering+ spraying GA_3 at 10 ppm	617.5	650.6	27.6	29.6	16	17.6
9 Removing 6 leaves at the 50% of flowering+ spraying GA_3 at 10 ppm	607	638.6	28.3	31	16	17
10 Removing 6 leaves at the 75% of flowering+ spraying GA_3 at 10 ppm	604.3	635.3	29	32	17	18
New L.S.D at 5%	38.8	39.1	0.6	0.8	0.4	0.9

4- Physical properties of berries:

Data in Table 5 show the impact of different treatments on berry weight and berry size in the both seasons of the research. Data clearly indicated superiority of leaf removal at 75% of flowering (T5) or spraying GA_3 at 10 ppm (T6) compared to leaf removal at the beginning of bloom or leaf removal at 25% and 50% of flowering (T2,T3 and T4). The treatment 75% of flowering (T5) recorded (2.77 & 3.09 g) for berry weight, (2.39 & 2.61 cm^3) for berry size throughout two seasons of study, Consecutively.

Table 5. Effect of leaf removal and GA_3 on Berry weight and Berry size of Thompson seedless Sultana ‘H_4 strain’ grapevines during both seasons

Characteristics	Berry weight		Berry size	
Treatments	2021	2022	2021	2022
1 Control	2.2	2.48	1.99	2.18
2 Removing 6 leaves at the beginning of flowering	2.37	2.61	2.07	2.3
3 Removing 6 leaves at the 25% of flowering	2.47	2.75	2.2	2.4
4 Removing 6 leaves at the 50% of flowering	2.63	2.91	2.36	2.53
5 Removing 6 leaves at the 75% of flowering	2.77	3.09	2.39	2.61
6 Spraying GA3 at 10 ppm	2.73	3.13	2.47	2.68
7 Removing 6 leaves at the beginning of flowering+ spraying GA_3 at 10 ppm	2.87	3.26	2.59	2.89
8 Removing 6 leaves from at the 25% of flowering+ spraying GA_3 at 10 ppm	3	3.33	2.61	2.86
9 Removing 6 leaves at the 50% of flowering+ spraying GA_3 at 10 ppm	3	3.32	2.76	2.96
10 Removing 6 leaves at the 75% of flowering+ spraying GA_3 at 10 ppm	3.23	3.53	3	3.17
New L.S.D at 5%	0.16	0.18	0.06	0.11

As for combined treatments, leaf removal at 75% of flowering + spraying GA_3 at 10 ppm treatment (T10) gave the greatest significant values in comparison to the control and the other treatments which recorded (3.23 & 3.35 gm) for berry weight and (3 & 3.17 cm^3) for berry size on two seasons of research, respectively. Conversely, the control treatment (T10) exhibited the least values in that respect were reported at (2.2 & 2.48 gm) for berry weight and (1.99 & 2.18 cm^3) for berry size during 2021 and 2022 seasons, respectively.

The results agree with Kaya (2019), who found that defoliation resulted in clusters with less berries, and did consistently decreased compactness of clusters, consequently leading to an increase in berry weight and berry size. Similarly, The impact of GA_3 is dependent on the timing of application and the concentration utilized. GA3 spraying at bloom stage lowered berry set due to its function in flower dropping, resulting in a lower number of berries per cluster and, consequently leading to an increase in berry weight and size (Gouda, 2021).

5- compactness of cluster, botrytis incidence and botrytis severity:

Regarding the influence of leaf removal and GA_3 on cluster compactness and *Botrytis* incidence and severity, table 6 reveal that sprayed Thompson seedless H_4 grapevines with leaf removal and GA_3 alone or in combination showed a decrease in the cluster compactness coefficient, also low *Botrytis* incidence and *Botrytis* severity comparing with control in both seasons. On this respect, sprayed Thompson seedless H_4 grapevines with leaf removal + GA_3 at 75% of flowering (T10) produced the lowest values for compactness coefficient of cluster (6.97 & 5.01), *Botrytis* incidence (12 & 8%) and *Botrytis* severity (4.83& 4.59%) in both seasons respectively, by this was followed by Thompson seedless grapevines sprayed with GA3 + leaf removal at the beginning of flowering (T7) without significant differences between them.

Conversely, the control (T1) recorded the most significant numbers for the compactness coefficient of the cluster (12.49 & 10.32), *Botrytis* incidence (28 & 24%) and *Botrytis* severity (9.86 & 10.52%), in both seasons respectively. No significant changes seen between the control (T1) and leaf removal at beginning of flowering alone (T2) regarding *Botrytis* incidence and Botrytis severity.

Compactness of bunch is a unique grapevine feature that influences berry quality and the sanitary status of the bunch (Tello and Ibáñez, 2018). Bunches Compactness had traditionally been linked with a significant sensitivity to bunch rot, mostly caused by the pressure exerted with the expanding berries, that might be induce berry shattering, juice leakage, and free water and nutrient availability for conidia germination and mold growth (Tello and Javier, 2014; Molitor *et al.*, 2015; Tello and Ibáñez, 2018). likewise, compact clusters are exposed to heterogeneous ripening due to enhanced intra-bunch variability in berry temperature and solar radiation interception (Smart and Sinclair, 1976; Tello and Javier, 2014).

The cluster's compactness coefficient reduced because of leaf removal and GA_3 led a drop in *Botrytis* incidence and *Botrytis* severity in comparison with the control, due to it plays a crucial part in berries thinning. Consequently, this treatment generated a bunch with lower compactness and higher quality. This drop might be attributed to a drop in berries number / cluster and boost in cluster length. These results are in agreement with data on the usage of GA_3 applied at the anthesis stage, that decreased flowers number compared to the control, as reported by Selim (2007); El-Salhy *et al.* (2009); Abu-Zahra (2010). Likewise, Wegher *et al.* (2022) demonstrated that in Pinot Gris, leaf removal and gibberellic (GA_3) acid treatment during early flowering lowered cluster compactness mostly by reducing berries number per bunch.

Defoliation at bloom or fruit set phases led to a significantly lower quantity of cluster berries, modifying cluster structure and decreasing compactness (Sabbatini *et al.*, 2015; Sternad Lemut *et al.*, 2015; Acimovic *et al.*, 2016). Furthermore, defoliation before or during the blooming phase increased compactness of cluster when comparison with defoliation implemented through the fruit set stage (Diego *et al.*, 2014).

The Results of Mosetti *et al.* (2016) indicated that leaf removal on 'Sauvignon Blanc' grapevines reduced incidence and severity of *Botrytis* bunch rot, whereas also minimizing the intensity of sunburn on the fruit. It is surmised from the study of Würz *et al.* (2020) that this procedure altered microclimate surrounding cluster, decreasing incidence of *Botrytis* bunch rot. Defoliation treatments reduced bunch rot occurrence, including *Botrytis cinerea* (Molitor *et al.*, 2011; Mosetti *et al.*, 2016). This might attributed to more flexible clusters with improved air and light penetration, as well as increased cluster exposure, which greater airflow and more efficient spray applications from blooming to harvest (Tardaguila *et al.*, 2010; Frioni *et al.*, 2017).

Table 6. Effect of Leaf removal and GA3 on Cluster compactness, Botrytis incidence and Botrytis severity% of Thompson seedless Sultana 'H₄ strain' grapevines during both seasons

Characteristics Treatments		Cluster compactness		Botrytis incidence (%)		Botrytis severity(%)	
		2021	2022	2021	2022	2021	2022
1	Control	12.49	10.32	28	24	9.86	10.52
2	Removing 6 leaves at the beginning of flowering	10.79	9.15	28	24	9.35	9.72
3	Removing 6 leaves at the 25% of flowering	10.04	8.56	25.33	21.33	10.92	11.44
4	Removing 6 leaves at the 50% of flowering	9.35	8.17	24	20	11.6	11.94
5	Removing 6 leaves at the 75% of flowering	8.36	7.22	20	16	5.53	5.06
6	Spraying GA_3 at 10 ppm	7.89	6.85	17.33	13.33	4.71	4.15
7	Removing 6 leaves at the beginning of flowering+ spraying GA_3 at 10 ppm	7.41	6.18	16	12	5.74	5.27
8	Removing 6 leaves from at the 25% of flowering+ spraying GA_3 at 10 ppm	6.84	5.86	16	12	6.16	5.75
9	Removing 6 leaves at the 50% of flowering+ spraying GA_3 at 10 ppm	6.55	5.51	12	8	5.38	5.27
10	Removing 6 leaves at the 75% of flowering+ spraying GA_3 at 10 ppm	6.97	5.01	12	8	4.83	4.59
New L.S.D at 5%		0.87	0.73	1.76	1.76	1.66	1.81

According to Molitor *et al.* (2012a); Molitor *et al.* (2015), leaf removal enhanced clusters' exposure to sun light and wind, which proved to be efficient for controlling *Botrytis cinerea*. Over three years, defoliation and foliar GA spraying, whether applied individually or in combination, increased fruit health and composition in a grape cultivar with compact bunches. These advancements were attributed to upgrades in cluster construction and the microclimate of the fruit zone (Hed and Centinari, 2021).

Early defoliation, which includes less than six basal leaves, has been verified in some research to be ineffective in minimizing cluster compactness; however, it is effective in decreasing the spread of bunch rot from infected to healthy berries, as well as enhancing fruit structure and crop load control in other varieties with large cluster sizes (Acimovic *et al.*, 2016).

6- Chemical characteristics of berries:

Table (7) shows that leaf removal and GA3 had a significant impact on content of soluble solids (SSC), total acidity, and SSC/acid ratio of berries when comparison to the control in two years of experiment. Vines sprayed with GA3 alone (T6) had a greater impact than leaf removal during bloom, with SSC (18.17 & 18.47%), acidity (0.55 & 0.45%), and percentage of SSC/acid ratio (32.91 & 4 0.54%) recorded throughout the two seasons of the research, respectively. Whereas, the control application (T1) produced the fewest values for SSC (16.13 & 16.53%), acidity (0.78 & 0.67%), and SSC/acid ratio (20.83 & 24.88%) in 2021 and 2022, respectively.

Vines sprayed with GA3 + leaf removal at 75% of flowering (T10) produced the highest values of SSC% and SSC/acid ratio, as well as lowest significant values of total acidity, with (20 & 20.2%) for SSC, (0.46 & 0.45%) for acidity, and (43.96 & 45.40%) for SSC/acid ratio, respectively. This followed with the treatment of GA_3 + leaf removal at 50% of flowering (T9) and GA_3 + leaf removal at 25% of flowering (T8) during the two seasons of the investigation.

Table 7. Effect of Leaf removal and GA3 on Soluble solids (SSC%), Acidity and SSC/acid ratio of Thompson seedless Sultana 'H4 strain' grapevines during both seasons

Characteristics Treatments		Soluble solids content (SSC%)		Acidity (%)		SSC /acid ratio	
		2021	2022	2021	2022	2021	2022
1	Control	16.13	16.53	0.78	0.67	20.83	24.88
2	Removing 6 leaves at the beginning of flowering	16.47	16.87	0.72	0.61	22.8	27.55
3	Removing 6 leaves at the 25% of flowering	16.77	17.1	0.72	0.61	23.29	28.03
4	Removing 6 leaves at the 50% of flowering	17.43	17.73	0.65	0.54	26.96	33.06
5	Removing 6 leaves at the 75% of flowering	17.77	18.07	0.59	0.48	29.86	37.25
6	Spraying GA3 at 10 ppm	18.17	18.47	0.55	0.45	32.91	40.54
7	Removing 6 leaves at the beginning of flowering+ spraying GA_3 at 10 ppm	18.7	19.2	0.52	0.43	35.97	44.67
8	Removing 6 leaves from at the 25% of flowering+ spraying GA_3 at 10 ppm	19.27	19.87	0.48	0.47	39.94	42.06
9	Removing 6 leaves at the 50% of flowering+ spraying GA_3 at 10 ppm	19.63	19.97	0.48	0.47	41.58	43.19
10	Removing 6 leaves at the 75% of flowering+ spraying GA_3 at 10 ppm	20	20.2	0.46	0.45	43.96	45.40
New L.S.D at 5%		0.24	0.29	0.03	0.03	1.59	1.59

Our results are in the same line with Abu-Zahra (2010), who studied the impact of GA_3 on fruit quality of Thompson seedless and shown that treating vines with GA_3 improved quality metrics like soluble solids content and decreased total acidity. Chaitakhob *et al.* (2014) found that treating vines with GA_3 at 50% full bloom and at fruit set stage (pea size) significantly raised TSS, decreased acidity and enhanced TSS/Acidity percentage in Perlette grapes.

The findings are reinforced by Shalan and Hamza (2020) and Abdel-Razek *et al.* (2010), who found that defoliation enhanced content of soluble solid (SSC%) and SSC/acid ratio while decreasing acidity in berries of 'Crimson seedless' grapes. This discovery is consistent with the observations of numerous researchers, who have shown that sunlight-exposed fruits had higher soluble solid content and lower titratable acidity than non-exposed or canopy shaded fruits (Fox and Lehr, 2006; Reynolds *et al.*, 2006). Likewise, Gatti *et al.* (2012) discovered comparable results, that might attributable to greater solar exposure in the cluster zone. Leaf removal resulted in increased fruit maturity, greater TSS, and reduced TA. The higher TSS of leaf removal vines when comparison with no leaf removal vines may be due to the enhanced sunshine exposure of leaves, resulting in less leaf layers and occlusion layers, that boosts carbon absorption potential (Keller, 2015).

Khalil *et al.* (2023) observed a slight increase in TSS with GA_3 application, and they noted a negative relationship between cluster compactness and TSS. This indicates TSS enhanced as the degree of compactness decreased. Additionally, Bubola et al. (2019) found that leaf removal before bloom had beneficial influence on content of soluble solid.

7- Tolal sugars and total carotenoids in berries:

Concerning the impact of leaf removal at flowering stage and spraying GA_3 on total sugars % of Thompson seedless 'H4 strain', the recorded data in Table (8) showed that spraying GA_3 + leaf removal at 75% of flowering (T10) gave the greatest values when comparison to other treatments, that values were (15 & 15.22%). Additionally, spraying the vines with GA_3 alone (T6) yielded the highest values compared to treatments involving leaf removal at flowering stage, recording (13.63 & 14.22%). Conversely, the control treatment (T1) exhibited the lowest values (12.10 & 12.73%) compared to other treatments of 2021 and 2022 seasons, respectively. The application of GA_3 individually or combined with NH_4NO_3, as well as Salicylic acid and NH_4NO_3, marginally improved the reducing sugars concentration % as observed by (Aiman *et al.*, 2022) on Ruby seedless, (Marzouk and Kassem, 2011) on Thompson seedless and (Radwan et al., 2019) on Superior Seedless. Defoliation practiced resulted in a raise in sugar accumulation, and °Brix as reported by (Bergqvist *et al.*, 2001; Poni *et al.*, 2006; Poni *et al.*, 2009; Diago *et al.*, 2012) and to a decrease in total acidity, as noted by (Bergqvist *et al.*, 2001; Spayd *et al.*, 2002; Poni *et al.*, 2009; Tardaguila *et al.*, 2010). However, Abada *et al.* (2015); El-Akad *et al.* (2021); Ibrahim *et al.* (2021) observed that GA_3 lowered the percentage of reducing sugar. VanderWeide *et al.* (2021) suggested that early leaf removal may have reduced cluster inflorescence owing to a reduction in available sugars. 'MidSouth' already exhibited a drop in soluble sugars accessible in its leaves during the blooming stage, as stated by (Jain *et al.*, 2002).

Also, results in Table 8 demonstrated the impact of leaf removal at flowering phase and spraying GA_3 on total carotenoids in berry skin. Data revealed that vines treated with GA_3 + leaf removal at 75% of flowering (T10) produced significantly higher values in this respect, which recorded (0.79 & 0.94 mg/ g FW) in two seasons of the research in comparison with all treatments. moreover, vines sprayed with GA_3 alone (T5) showed a more pronounced effect than treatments with leaf removal at flowering alone. In contrast, the fewest values of total carotenoid content in berry skin resulted from control vines (T1), which recorded (0.14 & 0.25 mg/ g FW) in two seasons of the study, respectively. When leaf removal are taken off early, better microclimate conditions result in enhanced biosynthesis of carotenoids, that boosts accumulation of isoprenoids and reduces the amount of 27 methoxypyrazines in fruit (Ryona *et al.*, 2008). Treating bunches with GA_3 at 10 to 40 ppm or Sitofex at 2.5 to 10 ppm considerably was supported with increasing total carotenoids of Early Sweet Grapes (Abada *et al.*, 2015).

Table 8. Effect of Leaf removal and GA3 on Total sugar and Total carotenoids of Thompson seedless Sultana 'H$_4$ strain' grapevines during both seasons.

Characteristics Treatments	Total Carotenoids (mg/ 100 g FW)		Total Sugar (%)	
	2021	2021	2022	2022
1 Control	0.14	0.25	12.10	12.73
2 Removing 6 leaves at the beginning of flowering	0.23	0.35	12.35	12.99
3 Removing 6 leaves at the 25% of flowering	0.38	0.50	12.58	13.17
4 Removing 6 leaves at the 50% of flowering	0.47	0.58	13.08	13.66
5 Removing 6 leaves at the 75% of flowering	0.52	0.64	13.33	13.91
6 Spraying GA_3 at 10 ppm	0.55	0.67	13.63	14.22
7 Removing 6 leaves at the beginning of flowering+ spraying GA_3 at 10 ppm	0.58	0.72	14.03	14.79
8 Removing 6 leaves from at the 25% of flowering+ spraying GA_3 at 10 ppm	0.62	0.77	14.45	14.63
9 Removing 6 leaves at the 50% of flowering+ spraying GA_3 at 10 ppm	0.65	0.85	14.73	15.38
10 Removing 6 leaves at the 75% of flowering+ spraying GA_3 at 10 ppm	0.79	0.94	15.00	15.22
New L.S.D at 5%	0.18	0.06	0.05	0.78

8- Total chlorophyll in leaves and total carbohydrates in cans:

The results in Table (9) show the impact of leaf removal at flowering stage and spraying GA_3 on total chlorophyll in leaves, data indicated that vines treated with GA_3 + leaf removal at 75% of flowering (T10) of Sultana H$_4$ grapevines had greatest values of total chlorophyll in leaves (5.46 &5.79 mg/g FW) followed by GA_3 + leaf removal at 50% of flowering stage (T9) in two seasons of study. In contrast, untreated vines (T1) produced the least values of chlorophyll content in leaves (0.99 &1.14mg/ g FW) in the two seasons of study.

These results are in agreement with those of Salehi *et al.* (2014). Also, Gao *et al.* (2020) who showed that the application of GA_3 increased leaf chlorophyll content in the Kyoho grapevine leaves. Additionally, in yellow-green skinned grapes, the color tone of the berry skin is primarily impacted by chlorophyll, with chlorophyll exerting the most effect (Lancaster *et al.*, 1997). Leaf removal has been shown to increase carbohydrate and chlorophyll content towards the final stage of the growth season, adjusting for higher levels of photosynthesis and respiration in the remaining leaves. This enables plants to minimize effects of leaf removal (Petrie *et al.*, 2003; Palliotti *et al.*, 2011). Also, the results in Table (9) indicate that vines treated with GA_3 + leaf removal at 75% of flowering (T10) produced significantly higher values of total carbohydrates in cans (25.5 & 25.63%) in two seasons of the study compared to other treatments. Also, vines treated with GA_3 alone (T5) showed a more pronounced effect compared to treatments with leaf removal alone on total carbohydrates content. In contrast, the least values of carbohydrates content were resulted from control vines (T1) which recorded (16.2 & 17.09) of carbohydrates per vine in both seasons of study respectively.

Table 9. Effect of Leaf removal and GA_3 on total chlorophyll in leaves and total carbohydrates in cans of Thompson seedless Sultana 'H$_4$ strain' grapevines during both seasons.

Characteristics Treatments	Total chlorophyll (mg/ g FW)		Total carbohydrates (%)	
	2021	2022	2021	2022
1 Control	0.99	1.44	16.2	17.09
2 Removing 6 leaves at the beginning of flowering	2.00	2.57	17.67	18.56
3 Removing 6 leaves at the 25% of flowering	2.94	3.42	18.8	19.69
4 Removing 6 leaves at the 50% of flowering	3.39	3.91	20	20.61
5 Removing 6 leaves at the 75% of flowering	3.9	4.30	21.67	22.38
6 Spraying GA_3 at 10 ppm	4.13	4.62	21.57	21.92
7 Removing 6 leaves at the beginning of flowering+ spraying GA_3 at 10 ppm	4.39	4.85	22.37	22.70
8 Removing 6 leaves at the 25% of flowering+ spraying GA_3 at 10 ppm	4.86	5.17	23.17	23.50
9 Removing 6 leaves at the 50% of flowering+ spraying GA_3 at 10 ppm	5.16	5.47	24.3	24.43
10 Removing 6 leaves at the 75% of flowering+ spraying GA_3 at 10 ppm	5.46	5.79	25.5	25.63
New L.S.D at 5%	0.33	0.35	0.97	0.95

Findings consistent with Noori *et al.* (2018), who found that early leaf removal had a substantial influence on carbohydrates content. Better microclimate conditions improve carbohydrate biosynthesis, promote nor isoprenoid accumulation, and reduce the level of 27 methoxypyrazines in fruit (Ryona *et al.*, 2008). The leaf removal of eight leaves during fruit set most likely limited carbohydrate transfer to the fruit, restricting berry growth. This finding is consistent with findings from studies in which leaves were removed manually at fruit set (Bubola *et al.*, 2019; VanderWeide, 2020).

9- Pruning weight and wood ripening:

Regarding the effect of Leaf removal and GA_3 on pruning weight, data from Table (10) reveal that the vines sprayed with GA_3 + leaf removal at 75% of flowering (T10) and vines sprayed with GA_3 + leaf removal at 50% at flowering (T9) produced the highest pruning wood weight with values of 2.83 and 2.84 kg and 2.80 and 2.90 kg, respectively in the two seasons. On the other hand, the control vines (T1) resulted in the lowest pruning weight (2.11 and 2.31 kg). Moreover, there were non-significant variations between treatments of leaf removal at other flowering times, especially in the second season. Finally, pruning weight is considered a good indication of vine vigor, reflected in the balance between fruit and vegetative growth.

These results are in harmony with Pinã and Bautista (2006), who indicated that pruning waste weight could be indicative of vine vigor. They found that the Sultanina grape cultivar exhibited the highest pruning weight, while the Moscatel de Alejandria cultivar showed the lowest pruning weight. According to Chalak (2008), the increase in pruning weight resulting from the low concentration of GA_3 may be attributed to enhanced vegetative growth, leading to efficient photosynthesis and carbohydrates accumulation, thereby increasing the fresh and dry weight of canes (Gao *et al.*, 2020). On the other hand, Dokoozlian and Peacock (2001) found no reduction in pruning weights as affected by applications of GA_3 over a 4-year period.

Table 10 also shows the results of the wood ripening coefficient, which is viewed an indication of vine vigor for Thompson seedless H_4 grapevines. The greatest values of wood ripening coefficient were observed in vines sprayed with GA_3 + leaf removal 75% of flowering (T10) and GA_3 + leaf removal on 50% at flowering (T9), with values of (0.92 & 0.93) and (0.90 & 0.92) in the 2021 and 2022 seasons, respectively. In contrast, no-significant differences were noticed between vines treated with leaf removal alone and untreated vines (control), which stated the fewest values of wood ripening coefficient in both seasons of study.

10- N% content in leaves and C/N ratio.

The results shows in Table (10) was the impact of Leaf removal and GA_3 on N% and C/N ratio. The data shows that vines sprayed with GA_3 + leaf removal at 75% of flowering (T10) exhibited the highest values in this respect, recording (1.19 & 1.26%) for N% and (21.47 & 20.34%) for C/N ratio in both seasons of the study, respectively. Furthermore, fewest values of N% content in leaves and C/N ratio were recorded in control vines (T10), which gave (0.86 & 0.96%) for N% and (19 & 17.96%) for C/N ratio in the 2020 and 2021 seasons, respectively.

Nitrogen plays a crucial role in various cellular processes, including the synthesis of proteins, protoplasm, enzymes, and organic compounds such as nucleoproteins, amino acids, and chlorophyll (Nijjar, 1985). The nitrogen impact at bloom stage involves the production of new tissues, which enhances water and nutrients absorption, leading to increased vegetative growth (El-Halaby *et al.*, 2015).

Table 10. Effect of and Leaf removal and GA3 on Pruning weight, Wood ripening %, N% content in leaves and C/N ratio of Thompson seedless Sultana ‘H_4 strain’ grapevines during both seasons

Characteristics Treatments	Pruning weight (Kg)		wood ripening		N (%)		C/N ratio	
	2021	2022	2021	2022	2021	2022	2021	2022
1 Control	2.11	2.31	76	77.67	0.86	0.96	19.00	17.96
2 Removing 6 leaves at the beginning of flowering	2.26	2.49	76.33	77.67	0.94	1.03	18.78	18.06
3 Removing 6 leaves at the 25% of flowering	2.21	2.4	78	80.33	1.02	1.1	18.39	17.94
4 Removing 6 leaves at the 50% of flowering	2.35	2.49	79	83.33	1.04	1.32	19.17	18.18
5 Removing 6 leaves at the 75% of flowering	2.47	2.58	86	84.33	1.07	1.17	20.31	19.23
6 Spraying GA_3 at 10 ppm	2.55	2.66	88	88.67	1.10	1.17	19.68	18.75
7 Removing 6 leaves at the beginning of flowering+ spraying GA_3 at 10 ppm	2.40	2.63	85	89.67	1.10	1.19	20.27	19.18
8 Removing 6 leaves from at the 25% of flowering+ spraying GA_3 at 10 ppm	2.59	2.68	86.67	87.67	1.12	1.2	20.68	19.58
9 Removing 6 leaves at the 50% of flowering+ spraying GA_3 at 10 ppm	2.8	2.9	90.33	92	1.15	1.22	21.09	19.98
10 Removing 6 leaves at the 75% of flowering+ spraying GA_3 at 10 ppm	2.83	2.84	91.67	93	1.19	1.26	21.47	20.34
New L.S.D at 5%	0.20	0.23	9.27	7.38	0.05	0.04	1.16	0.91

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استخدام إزالة الأوراق والرش بحامض الجبريليك (GA_3) لتقليل معامل تزاحم العنقود وتحسين الخصائص الكيميائية والفيزيائية لصنف عنب الطومسون سيدلس H4

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الملخـص

أجريت هذه الدراسة خلال موسمي (2021 & 2022) في مزرعة البرامون بالمنصورة – محافظة الدقهلية التابعة لمعهد بحوث البساتين – مركز البحوث الزراعية على كرمات عنب الطومسون سيدلس سلالة (H_4) المطعوم على اصل الفريدم عمرها 7 سنوات ومنزرعة في تربة طينية وتروى بنظام الري بالغمر ومنزرعة على مسافة 2×3 م ومرباه بالطريقة القصبية وتحت نظام التدعيم البارون. وكان الهدف من هذه الدراسة هو تقليل معامل تزاحم العنقود وتحسين الصفات الطبيعية والكيميائية للعنقود والحبات لهذه السلالة. حيث تم إزالة الأوراق أربع مرات منفردة أو مجتمعة مع تطبيق الرش بالجبريليك GA_3، والتي طبقت بإزالة 6 أوراق في بداية التزهير، 25٪ من التزهير، 50٪ من التزهير وعند 75٪ من التزهير لمقارنة تأثير هذه المعاملات على أداء عنب الطومسون سيدلس (سلالة H_4) خلال موسمي 2021 و 2022. أظهرت النتائج أن إزالة 6 أوراق عند 75% من التزهير بالإضافة إلى رش الجبريليك GA_3 بمعدل 10 جزء في المليون كان له تأثير معنوي في تحسين صفات العنقود والحبات مقارنا بالكنترول حيث أدى ذلك الى تحسين النمو الخضري والنيتروجين الكلي ومحتوى الكربوهيدرات في القصبات وزيادة طول وعرض العنقود وبالتالي انخفض معامل تزاحم العنقود وتحسين مظهر وشكل العنقود. كما أظهرت النتائج أيضا زيادة وزن العنقود ووزن وطول وعرض الحبات وتحسين صفات الجودة في الحبات مثل المواد الصلبة الذائبة ونسبة المواد الصلبة الذائبة الى الحموضة والسكريات الكلية والكاروتينات الكلية وخفض نسبة الحموضة في عصير الحبات. في حين أدت نفس المعاملات إلى تقليل معامل التزاحم للعنقود وكذلك نسبة حدوث الأعفان وشدتها مما يؤدى الى تحسين صفات وشكل العنقود والحبات وكذلك الصفات الكيميائية والفيزيائية وبالتالي تحسين القيمة التسويقية لصنف عنب طومسون سيدلس H_4.