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Evaluation of some physical and chemical characteristics of two grape cultivars under irrigated and non-irrigated conditions

Anwar Mohammed Raouf Mahmood[1], Sidiq Aziz Sidiq Kasnazany[1*], Avin Noori Mirza[2], Hezha Adil Omer[2]

[1] **Horticulture Department, College of Agricultural Engineering Sciences, University of Sulaimani, Kurdistan Region, Iraq.**
[2] **General Directorate of Agriculture of Sulaimani, Sulaimani, Iraq**
[*]**Corresponding author email:** sdiq.sdiq@univsul.edu.iq

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Abstract

This study carried out in Kanipanka Agricultural Research Station Sulaimani governorate, Kurdistan region, Iraq. The experiment contained of three vines of each cultivar (Tre-rash and Rash-miree) were selected, and it was cultivated in two methods (irrigated and non-irrigated) previously. The total of vines were 12 which have about (15) years. Using Randomized Complete Block Design (RCBD) with 3 replicates. Duncan's multiple ranges ($p \leq 0.05$) used to compare the means XLSTAT software used for data analysis. The aim of this study was to determine the influence of the two methods for the cultivation on two grape cultivars aforementioned and their effects on the physical and chemical properties. Results indicated that Tre-rash cultivar superior Rash-miree cultivar in term of the number of berries per cluster, total sugar, pH value, number of seeds per berry, cluster weight and firmness. On the other hand, Rash-miree cultivar significantly superior Tre-rash cultivar regarding the berry diameter and length, Titratable acidity, weight and size of 100 berries, anthocyanin, weight of pulp per 100 berries. Concerning the cultivation methods of grapevine where registered the highest vitamin C, TSS, total sugar, pH, cluster weight, weight and size of 100 berries, anthocyanin and weight of pulp per 100 berries when cultivation non-irrigated. Additionally, the interaction between Rash-miree cultivar with non-irrigated cultivation showed significant superiority more the studied traits.

Keywords: Grapes, irrigated cultivation, rain-fed vineyard, Cultivars, Quality parameters.

Introduction

Grapes (*Vitis vinifera* L.) belongs to Vitaceae family, is one of the most important horticulture fruits on the world and also in Iraq, since to human dominion in the Mesopotamian Valley grape is familiar and growing and nowadays more than 75 cultivars are grown the majority are in Kurdistan region in Iraq [1,5]. Grapes may be consumed fresh as table grapes or they may be used to make wine, raisins, juice, jelly, jam, grape seed extract, vinegar and grape seed oil.

Grapevine adapts fully to cultivation in arid or semi-arid climates and it accordingly considered as a water deficit tolerant species. These adaptations may be due to the grapevines root have deep and wide system, moreover grapevine physiologically have effective mechanism of stomatal control and the ability to osmotic adjustment [2,12]. On the other hand, with some agricultural practice, soil, water and conditions are made irrigations are not common except those areas that use their grapes to wine produce [3, 6]. Furthermore, photosynthesis and water use efficiency are improbable to be uniform among varieties due to the large genetic heterogeneity among varieties also have various ability to tolerate the stress and to acclimate in various conditions [13, 24, 16].

The climate has an important role on grape yield and quality wherefore producers are care to the changes in climate and work to decrease their effects. The water effect on vegetative growth greater than reproductive growth. At water stress, in grape vine caused a lowering in shoot growth is the first visible symptoms also, decrease the leaves area [55], furthermore, water stress can change the fruit quality, whichever positively or negatively, depending on during and amount of water stress [44]. In contrast, increasing soil water can lead to too much vine vegetative growth, forming a shaded canopy that may be caused unfavorable fruit quality and could rise the risk of fungal diseases [38]. For many red grapevine cultivars, berry quality relies upon a progressive reduction of water availability after flowering to reach moderate water deficit during the ripening phase [43, 42].

Vineyards irrigations system are not a common agricultural practice in Kurdistan and most productive areas of the world but the most popular are rain-fed cultivation. In the last decades, Kurdistan Region of Iraq adversely affected by a large-scale semi-aridization of the climate which is illustrious by increasing in temperatures and the deterioration of the amount of precipitations along with clearly visible drying of vegetation cover and surface water. Water shortage that is predictable to rise due to climate change might be negatively effects on agricultural production [4].

The relationships between water availability and grape berry yield and quality, with the identification of relevant variables to determine the level of water deficit, although a few numbers of studies have conducted in the past. Therefore, the aim of our study is to determine the effects of cultivated methods (irrigated and rain-fed) on both (Trerash and Rash-miree) grape varieties in terms of some characteristics of physical, chemical composition, and quality of grape berry fruits.

Materials and Methods

Study location

This study carried out in 2019 the samples were taken in Kanipanka Agricultural Research Station which located in Shahrazoor valley, 35 Km east of Sulaimani governorate, Kurdistan region, North-East of Iraq (35°13'12" N, 45°25'48" E) in. Figure (1) show the study sites that GIS software used to create it.

Some physical and chemical properties of the study location soil and metrological data during the study period are shown in the tables (1 and 2) respectively. The study area climate is generally warm, dry summer and cold winters [41].

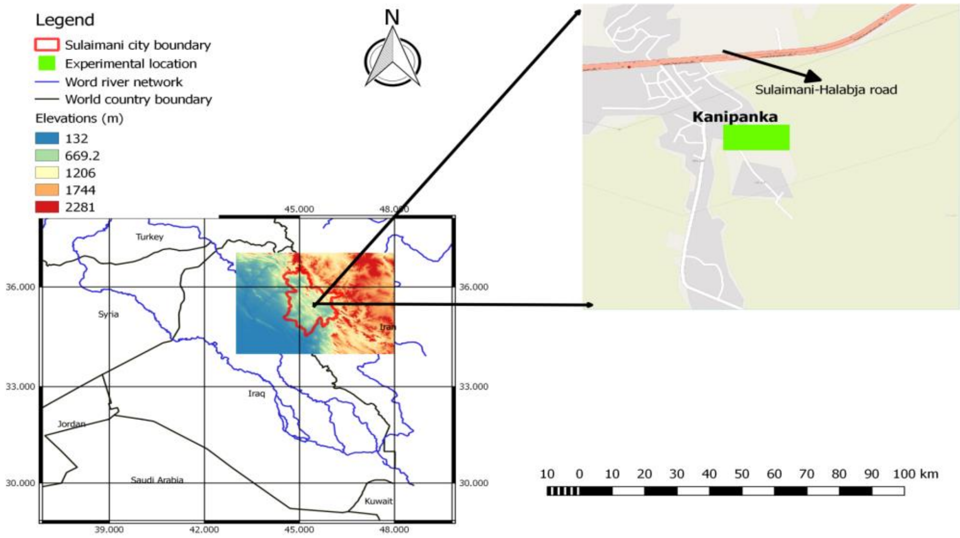

Figure (1): Site study of the experiment.

Table (1): Some physical and chemical properties of location soil.

Soil components	Sand	Silt	Clay	Textured name	pH	EC	Organic Matter
	g kg^{-1}					dS m^{-1}	g kg^{-1}
Values	214.0	540.0	246.0	Silty Loam	7.10	0.16	22.3

Table (2): Some meteorological data of the study location during the study period (2019-2020).

Months	Temperatures C°			precipitations (mm)	Avg. Humidity %
	Max.	Min.	Avg.		
September 2019	35.5	22	28.8	0.0	33
October 2019	28.8	17.2	23	71.8	47.3
November 2019	19.8	9.7	14.7	16.4	48.6
December 2019	14	6.4	10.2	144.5	69.9
January 2020	10.5	3.2	6.9	104.1	73
February 2020	11.7	3.6	7.7	136.5	70
March 2020	18.7	8.6	13.6	188	62.9
April 2020	22.6	12.6	17.6	71.2	59.7
May 2020	30.8	18.5	24.6	13.4	41.4
June 2020	36.6	23.1	29.8	0.1	30.3
July 2020	41	28.5	34.7	0.0	25.7
August 2020	38.6	25.7	32.2	0.0	28.1

Brief description of studied grape varieties:

Tre-rash and Rash–miree are the popular cultivar of grapevines in Kurdistan region there are late black variety (red-violet to dark-black); they are treated as a good table grape and could be used in industries to wine, juice and raisin [8 and 40].

1. Rash–miree

This cultivar considered a good juicy-fleshy fruit, planted in several areas of Sulaimani governorate, especially Dookanyan and Sharbazher zones. It has good commercial properties with physiologically female flowers or functionally pistillates so they need pollinizers, and planted among perfect hermaphroditic varieties. The cluster is usually cylindrical-conical in shape, large-sized berries, few oval and large-sized, dark black color, juicy textured, heavily waxy, pulp juicy-fleshy thickly skins, number of seeds 1-4, juice pink with a little acidity having a special flavor [5, 3], as shown in (picture 1-a).

2. Tre-rash:

In addition, called khoshnaw is a local grape variety planted in several areas of Erbil and Sulaimani. It is a late black variety, a good juicy grape and could be use as table grape and wine. The cluster is usually cylindrical-conical shape, medium to large size. The berries are oval. The berries are compact in the bunch. The color of the berries is dark-black or red-violet, sometimes covered with a thick layer of bloom. The pulp is juicy. The skin is medium in thickness with astringent taste because of tannin presence. The color of the juice is light pink. There are 1-3 seeds in each berry of medium size. It is recognize by its high productivity. The inflorescence is hermaphroditic and so is a good pollinizer for pistillate varieties such as Rash-miree, Miranee and others [5, 3 and 49], as shown in (picture 1-b).

a- Rash–miree grape

b- Tre-rash grape

Figure (2): The grape fruit phenotype of the studied cultivars

Experimental design and statistical analysis

The experiment contained of three replications, three vines of each variety (Tre-rash and Rash-miree) were selected, and it was cultivated in two methods (irrigated and non-irrigated) previously. The total of vines was 12 which have about (15) years. Using Randomized Complete Block Design (RCBD) with three replicates. Duncan's multiple ranges ($p \leq 0.05$) used to compare the means. XLSTAT software was use for data analysis. All taken vines in this study were applied the same horticultural practices. The fruits harvested in August 20 when the berries get full color. Six clusters from each cultivar harvested and stored in cold box, and immediately transported to the laboratory of Horticulture Department College of Agricultural Engineering Sciences.

Grapes Berries were harvested at the ripe stage (marketable stage), and data were collected on various parameters. Number of berries in a cluster, cluster weight (g), weight of 100 berries (g), size of 100 berries (cm^3), diameter and length of berries (mm), pH value was determined according to [15]. Juice (%) determined with the method described by [8]. Total acidity (%) and total soluble solids (TSS %) were determined as described in [7]. Total sugar (%) determined with the method described by [31]. Ascorbic acid (mg/100g FW) the method used for determination was described by [21]. Anthocyanin (mg/100g) and phenol (mg/100g) as described in [46]. Moisture content (M %) has been determined using the method described by [28]. Firmness (g) was determined according to [47]. Number of seeds in berry, weight of 100 seed and weight of pulp/100 berries.

Results and Discussion

Effect of cultivars on grape properties

Figure (3) show the effect of cultivar on number of berries per cluster, juice percentage, vitamin C and moisture content. Significant effect of cultivars on number of berries per cluster was illustrated, Tre-rash cultivar recorded maximum value (162.77) and Rash-miree cultivar gave the lowest (66.60) number of berries per cluster, these differences may be due to the cultivars have different ability in vegetative growth, chemical and physical of grape characteristics. Moreover, the genetic ability of the cultivar might cause enhance the nutrient uptake and that mean more growth [36, 2]. On the other hand, no significant differences observe between cultivars in juice percentage. The same trend was true for vitamin C and Moisture percentage.

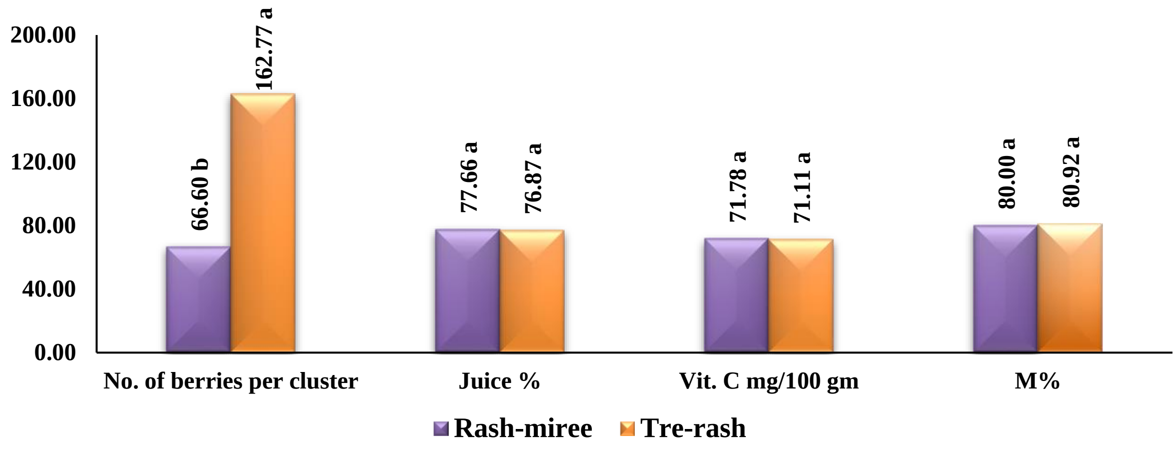

Figure (3): Effect of cultivars on number of berries/cluster, juice %, vitamin C and moisture%.

Figure (4) demonstrate the effect of grapevine cultivars on berry diameter and length, TSS %, total sugar% and weight of 100 seed. With respect grape berries diameter and length, the maximum value (18.13 and 20.52 mm) recorded from the Rash-miree cultivar, respectively, whereas, the minimum value (14.59 and 16.39 mm) recorded from the Tre-rash cultivar, respectively. [29] described that variation of grape berry length and width under genetic control and it is various from genotype to another. With regard to TSS % and weight of 100 seed, no significant differences were found between for both cultivars. Furthermore, the highest value (12.05 %) of total sugar% obtained from the Tre-rash cultivar, whereas, the least value (11.25 %) was from the Rash-miree cultivar. these differences present between cultivars are genetically controlled causing grape cultivars to differ over a considerable range. [52] reported that total sugar affected by the genotype.

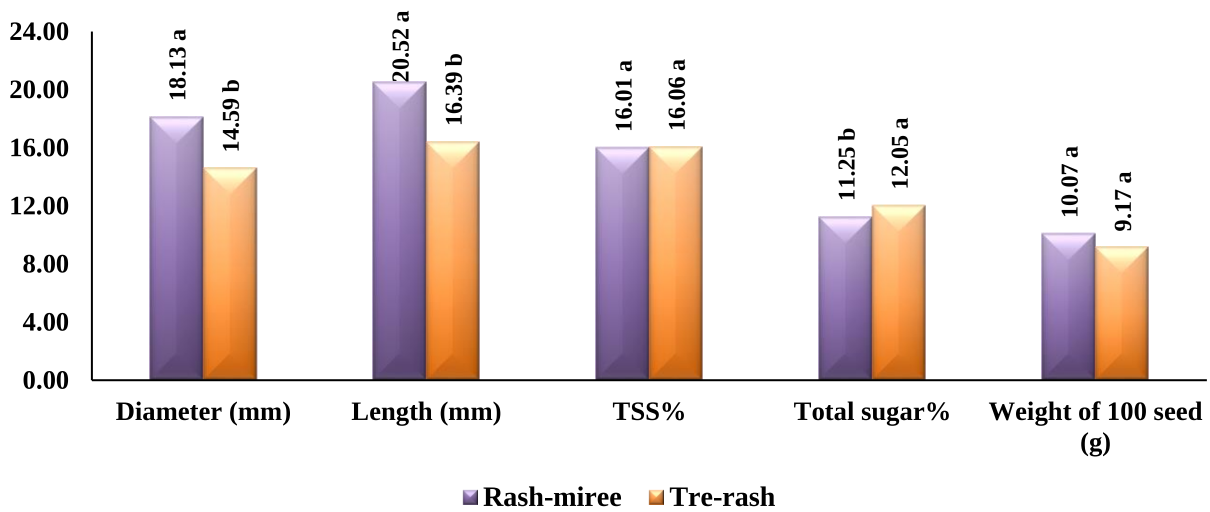

Figure (4): Effect cultivars on berries diameter, length, TSS%, total sugar% and weight of 100 seed

Based on the data of our investigation (Figure 5), the highest value (3.09) of pH recorded in Tre-rash cultivar. The least value (2.90) was resulted in the berry fruits of Rash-miree cultivar. In contrast, Rash-miree grape fruits gave the highest value (0.48%) of total acidity but the lowest (0.36%) was from the Tre-rash cultivar. Titratable acidity directly related to the concentration of organic acids present in the fruit [52]. On the other hand, [22] mentioned that the amount of pH and total acidity under genetic control. The cultivar has a significant effect on the number of seeds per berry, Tre-rash cultivar gave the highest value (1.94), while, the lowest value (1.64) was from Rash-Miree cultivar. [17] described that seed number differs from genotype to another.

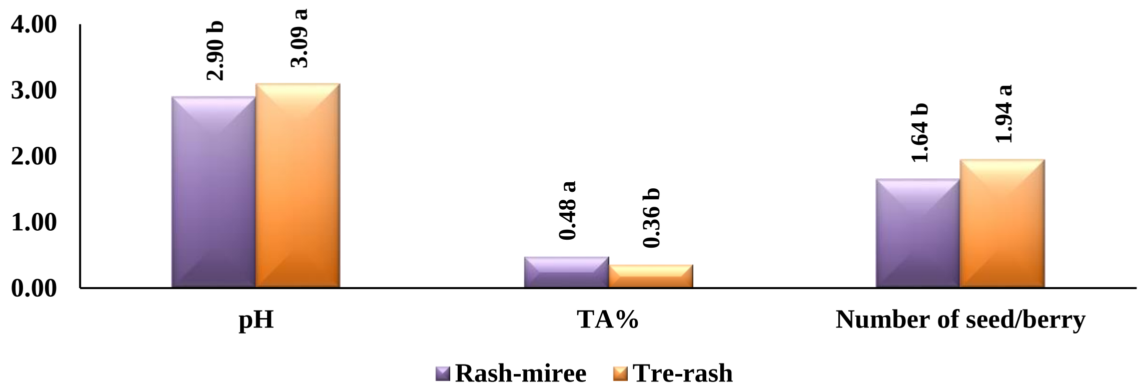

Figure (5): Effect of grape cultivars on pH, TA % and number of seed/berry.

Data in figure (6) clearly indicated that the highest (475.27 g) cluster weight was obtained in Tre-rash cultivar, while, the lowest (376.24 g) recorded from Rash-miree cultivar. With respect to weight and size of 100 berries, the maximum value (428.43 g and 444.38 cm^3) resulted from the Rash-miree cultivar, successively. Whereas, the minimum value (228.25 g and 234.38 cm^3) recorded from Tre-rash cultivar, respectively. Cultivars achieved significant differences in cluster weight, weight and size of 100 berries [1] declared that grapes have high variability in morphological features including cluster weight. The difference between berries size may be due to that low gene flow caused diversity between cultivars [50 and 53]. As described by [23] the berry weight differs according to grape varieties.

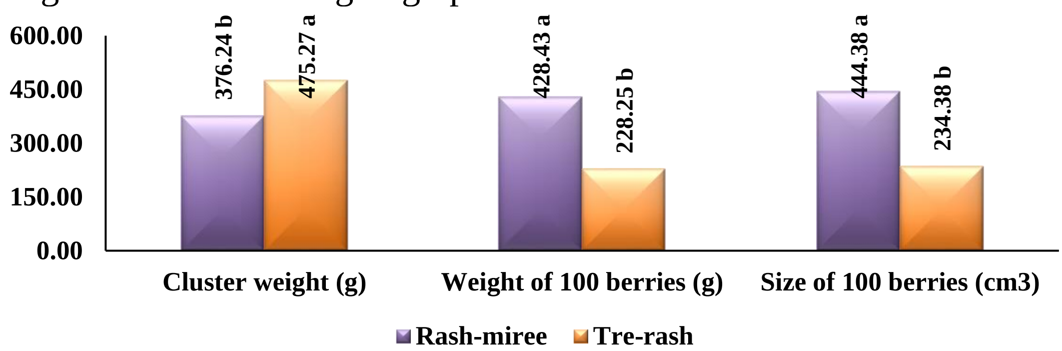

Figure (6): Effect of grapevine cultivars on cluster weight, weight and size of 100 berries.

Data presented in figure (7) showed the effect of cultivars on anthocyanin, phenol, firmness of berry and weight of pulp per 100 berries. The highest anthocyanin (221.31 mg 100g^{-1}) was observed from the Rash-miree cultivar, while; the lowest values (115.18 mg 100g^{-1}) were recorded from the Tre-rash cultivar. Generally, anthocyanin content in grape berries may be affect by cultivars. These results also agree with those obtained by [26]. With respect to phenol content, no significant differences found between both cultivars (Rash-miree and Tre-rash) during the study.

In the same figure, with regard to berry firmness, Tre-rash cultivar was significantly more firm than Rash-miree grape. It is axiomatic that cultivars have different value in firmness characteristic. Berry firmness of Rash-miree cultivar is usually greater than that of Tre-Rash due to the fact, that the weight and volume of berries in Rash-miree is greater and consequently having a greater skin surface area than Tre-rash [5], These findings were in dis-agreement with our results.

The weight of pulp per 100 berries recorded the highest value (469.73 g) in Rash-miree cultivar, while, the lowest value (252.42 g) obtained from Tre-rash cultivar. These results caused increase in the weight of pulp per 100 berries in Rash-miree cultivar, [32] described that Tre-rash cultivar possess a juicy pulp and semi-thick skin were Rash-miree cultivar have a juicy-flesh pulp and thick skin.

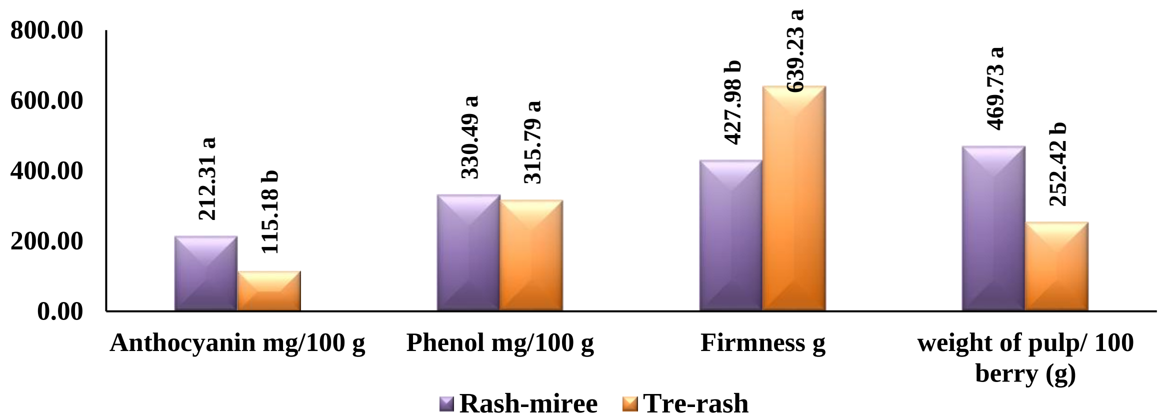

Figure (7): Effect of grape cultivars on anthocyanin, phenol, firmness and weight of pulp per 100 berries.

Effect of cultivation methods on grape properties

Figure (8) clarify the effect of cultivation methods on number of berries per cluster, juice %, vitamin C and moisture content. Cultivation methods significantly increased the number of berries per cluster, in irrigated method, maximum value (130.604) was recorded and non-irrigated method gave minimum value (98.771) these variations may be due to in flowering stage of grapevine the water stress have adverse effect and causes decrease fruit set [9]. The effect of cultivation method did not record significant differences in juice percentage of berries. Otherwise, the vitamin C significantly affected by cultivation methods, in non-irrigated method maximum value (74.121 mg/100gm) obtained, while the minimum value (68.774 mg/100gm) achieved in irrigated method. In

August before maturation of berry grapes, the drought stress and heat stress will be appearing as a result the plants have several responses and strategies to decrease the negative effects increase the vitamin C content is one of those responses. Vitamin C can control the free radicals produced, and protect the plant from the active oxygen disadvantages, moreover vitamin C has a role to keep the cell membrane stabile during the stress [34, 33]. As well as irrigated method recorded (81.091 %) fruit moister content compare non-irrigated method that gave (79.829 %), the variation between the methods was significantly, it is axiomatic that fruits in irrigated method have more water content.

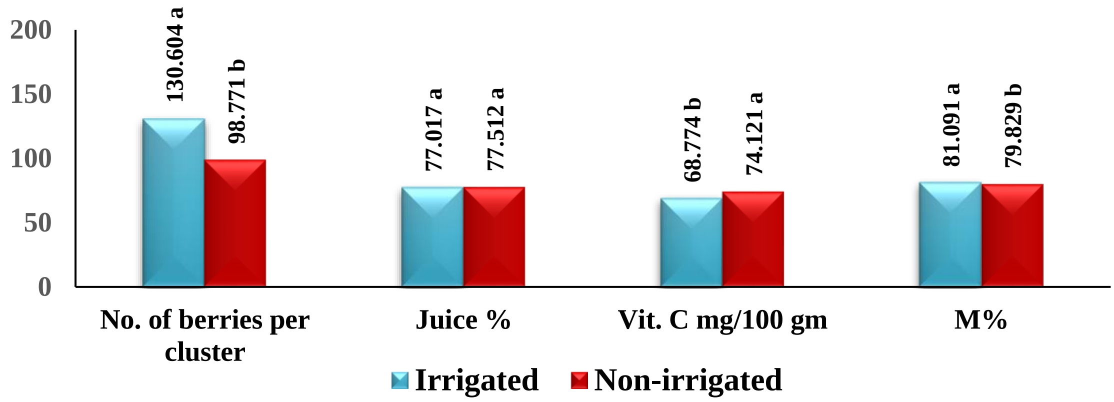

Figure (8): Effect of cultivation methods on number of berries per cluster, juice %, vitamin C and moisture content.

Effect of cultivation method on berries diameter, length, TSS %, total sugar% and weight of 100 seed determined to figure (9). Cultivation methods affected significantly on all parameters. Non-irrigated method gave maximum value (18.026 mm, 19.874 mm, 18.573%, 13.083% and 10.890 g) for prior parameters, respectively. Whereas minimum values (14.694 mm, 17.034 mm, 13.490%, 10.215% and 8.349 g) achieved in previous parameters, respectively.

As a result, to irrigation the vegetative growth will be increase, caused shading on clusters and decreases light intensities and may be led to small berries were produce [51]. As grapevines have a senior inclination to compensate [27] the decreased berries number per cluster in non-irrigated method may be compensate by increased in berries size. Regarding to TSS and total sugar, the reduction of irrigation water may cause increasing abscisic acid signaling in grape berry, which have positive effects to accumulate of the total soluble solids and due to the loss of berries water [18, 19] mentioned that in one hand, ABA together with sugar increases in water deficits and in another hand, by response to water deficit sugars were accumulate by osmoregulation and both factors caused sugar increase in non-irrigated method. Increase weight of a hundred seed in non-irrigated method may be due to the weight of berries, as mentioned [23] whereas there is correlated relation between seed weight and total berry weight.

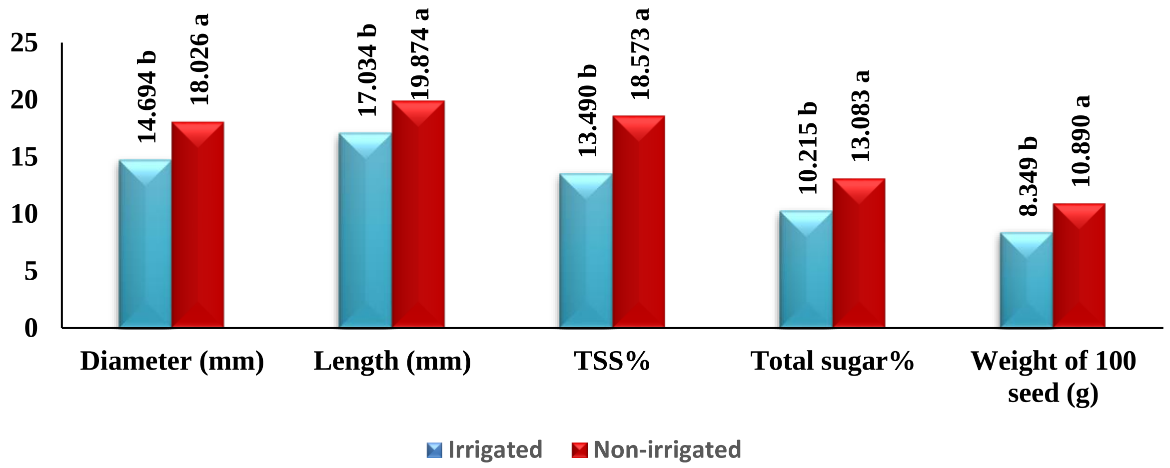

Figure (9): Effect of cultivation methods on berries diameter, length, TSS%, total sugar% and weight of 100 seed.

The efficiency of irrigated method in comparison to the non - irrigated method of pH, TA % and number of seeds/berry on grapes cultivated under different cultivation methods.

Results in figure (10) indicated that the high pH value content (3.077) was recorded in non-irrigated method, Meanwhile, the lowest value (2.913) was recorded in irrigated method. Vice versa, the total acidity significantly affected by cultivation methods, in irrigated method was recorded the maximum value (0.502%) while the minimum value (0.333 %) gave from non-irrigated method. [39] showed that the decreasing in pH have a link with an increasing in TA. On another hand, the increase of TA in irrigation method may be due to higher malic acid content [20]. No statistically significant differences were observed between the number of seeds per berry in both methods of cultivation, as the highest value (1.810) was recorded in the irrigated method and the lowest number (1.777) recorded from non-irrigated method, may be due to this trait is linked to genetics properties [5].

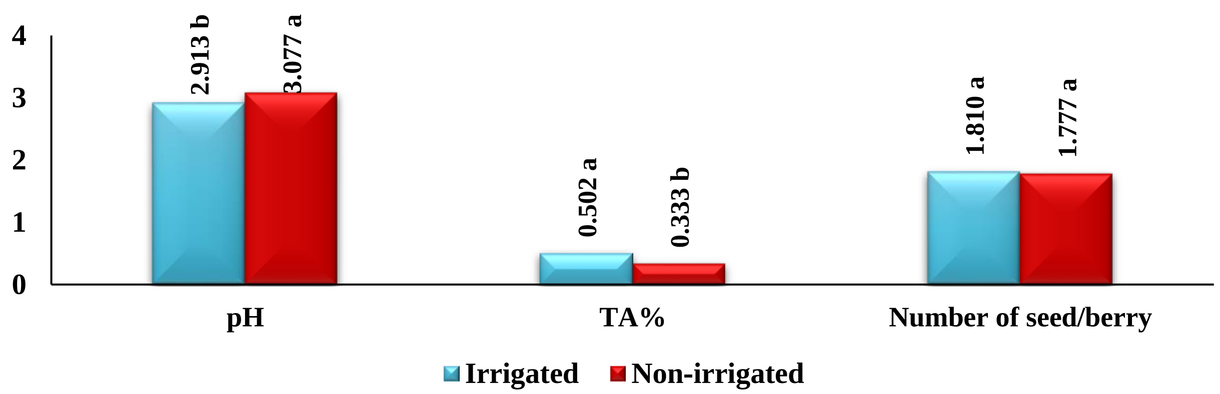

Figure (10): Effect of cultivation methods on pH, TA% and number of seed per berry.

Figure (11) Illustrate that non-irrigated cultivation method significantly affected on cluster weight, weight and size of 100 berries, superlative values (484.740 g, 399.187 g and 394.375 cm^3) respectively recorded for previous parameters and minimal values of same parameters were (366.771 g, 257.493 g and 284.375 cm3) respectively.

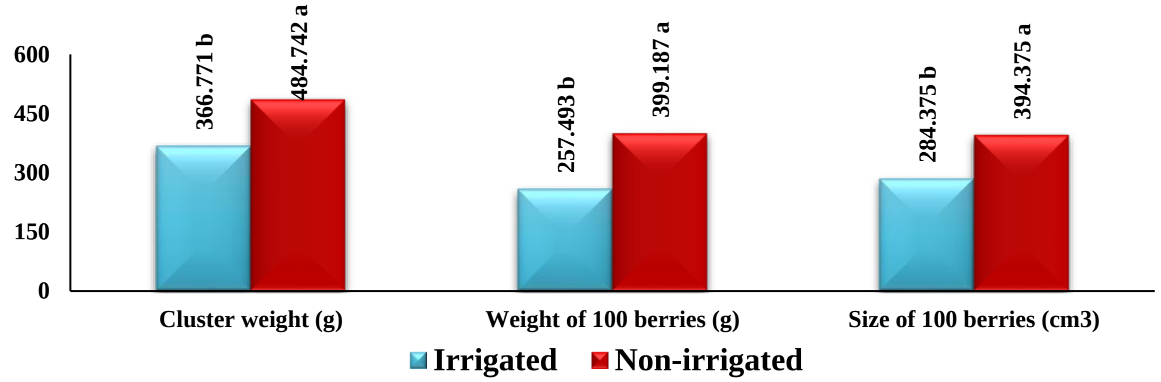

Figure (11): Effect of cultivation methods on cluster weight, weight and size of 100 berries

Effect of cultivation methods on anthocyanin, phenol, firmness and weight of pulp per 100 berries shown in figure (12). Significant differences between irrigated and non-irrigated method on anthocyanin, the highest value (184.680 mg/100g) observed in non-irrigated method and the lowest value (142.810 mg/100g) was record from other method. This can be associated with the elevated abscisic acid (ABA) signaling since ripening stage, which lead to anthocyanin biosynthesis [30]. Despite of non-irrigated method recorded maximum value of phenol (328.451 mg/100g) and minimum value (317.822 mg/100g) but these differences not reached to significant value. Cultivation methods significantly affected on firmness, the highest value (551.174 g) was recorded in non-irrigated method, but the lowest value (516.040 g) was obtained in irrigated method, as a result of drought condition abscisic acid was increased and as described by [10] that ABA effect on tomato primary metabolite accumulation and firmness of texture. Furthermore, weight of pulp per 100 berries affected significantly by cultivation methods the values were (389.463 and 332.690 g) for non-irrigated and irrigated method respectively.

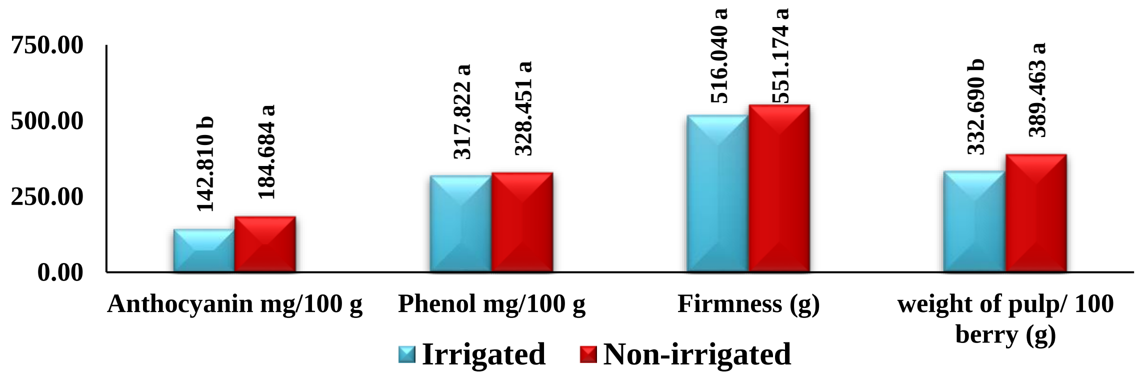

Figure (12): Effect of cultivation methods on anthocyanin, phenol, firmness and weight of pulp per 100 berries

Effect of interactions between cultivars and cultivation methods on grape properties:

As illustrated in table (3), the effect of interactions between cultivars and cultivation methods on number of berries per cluster, juice%, vitamin C and moisture content. The interactions between Tre-rash cultivar in irrigated conditions achieved maximum value (204.938) and it was significantly differs compared to other interactions in a number of berries per a cluster. Significant effect observed in interactions between both factors on juice%, the maximum value (79.305%) recorded in interaction between Rash-miree cultivar and non-irrigated method, the other cultivar in same condition gave minimum value (75.719 %). With respect to vitamin C, the highest value (80.195 mg/100gm) was found from the interaction between Rash-miree cultivar and non-irrigated. While, the lowest value (63.013 mg/100gm) was from the interaction between Rash-miree cultivar and irrigated method. The interactions between cultivars and agricultural methods significantly affected on moisture content, Rash-miree cultivar in irrigated condition gave maximum value (82.050 %), while in an opposite condition same cultivar recorded minimum value (77.950 %). These results may be due to the effect of the factors individually.

Table (3): Effect of interactions between cultivars and cultivation methods on number of berries per cluster, juice %, vitamin C and moisture content.

Cultivars	Cultivation method	No. of berries per cluster	Juice (%)	Vit. C (mg/100 gm)	M (%)
Rash-miree	irrigated	56.271 b	76.013 b	63.368 c	82.050 a
	non-irrigated	76.938 b	79.305 a	80.195 a	77.950 c
Tre-rash	irrigated	204.938 a	78.020 ab	74.180 b	80.131 b
	non-irrigated	120.604 b	75.719 b	68.048 c	81.708 a

It is clear from table (4) that the effects of combination between cultivars and cultivation methods of berries diameter, length, TSS %, total sugar% and weight of 100 seed. The most effective treatment in this respect was Rash-miree cultivar with non-irrigated cultivation method recorded the highest berry diameter and length, TSS%, total sugar% and weight of 100 seed where it gave (19.270 mm, 21.236 mm, 19.456 %, 12.735% and 9.769 %), respectively. Besides, no significant differences were found between the last treatment combination with Tre-rash cultivar and non-irrigated cultivation method on total sugar % was obtained 13.431%. While, Tre-rash cultivar and irrigated method gave the lowest berry diameter and length, and weight of 100 seed, (12.402 mm, 14.267 mm, and 7.532 g), respectively. On the other hand, Rash-miree cultivar and irrigated cultivation method gave the lowest TSS % and total sugar% among all treatments, (12.556 % and 9.769 %), successively.

Table (4): Effect of interactions between cultivars and cultivation methods on berries diameter, length, TSS%, total sugar% and weight of 100 seed.

Cultivars	Cultivation method	Diameter (mm)	Length (mm)	TSS (%)	Total sugar (%)	Weight of 100 seed (g)
Rash-miree	irrigated	16.986 b	19.801 ab	12.556 d	9.769 c	9.176 ab
	non-irrigated	19.270 a	21.236 a	19.456 a	12.735 a	10.963 a
Tre-rash	irrigated	12.402 c	14.267 c	14.423 c	10.662 b	7.523 b
	non-irrigated	16.782 b	18.513 b	17.690 b	13.431 a	10.817 a

Data presented in (table 5) listed the effect of interaction between cultivars and cultivation methods on pH, total acidity and number of seeds per berry. The highest pH and number of seeds per berry noticed in the treatment combination of Tre-rash cultivar with irrigated while, the least value obtained from Rash-miree cultivar with irrigated method. With regard to the TA % in berry grape, the lowest value (0.252%) was observed in the interaction between Tre-rash cultivar with non-irrigated cultivation method, On the other hand, the highest value (0.539%) recorded in the interaction between Rash-miree cultivar and irrigated method. May be these variances among data returned to the effect of the factors individually.

Table (5): Effect of interactions between cultivars and cultivation methods on pH, TA% and number of seed/berry.

Cultivars	Cultivation method	pH	TA%	Number of seed/berry
Rash-miree	irrigated	2.502 c	0.539 a	1.460 c
	non-irrigated	3.292 a	0.414 b	1.827 ab
Tre-rash	irrigated	3.325 a	0.464 b	2.160 a
	non-irrigated	2.862 b	0.252 c	1.727 bc

Results shown in table (6) indicate that the highest value of cluster weight, weight and size of 100 berries were obtained from the interaction between Rash-miree cultivar with non-irrigated method, the values were (507.005g, 501.053g and 457.708cm^3), respectively. While the lowest cluster weight (245.482g) recorded in same cultivar with irrigated cultivation method. On the other hand, with respect, weight and size of 100 berries were obtained in interactions between (Tre-rash cultivar and irrigated cultivation method) the values were (159.187g and 137.708cm^3) respectively.

Table (6): Effect of interactions between cultivars and cultivation methods on cluster weight, weight and size of 100 berries.

Cultivars	Cultivation method	Cluster weight (g)	Weight of 100 berries (g)	Size of 100 berries (cm^3)
Rash-miree	irrigated	245.482 b	355.798 b	431.042 ab
	non-irrigated	507.005 a	501.053 a	457.708 a
Tre-rash	irrigated	488.060 a	159.187 c	137.708 c
	non-irrigated	462.479 a	297.320 b	331.042 b

Table 7 demonstrated the effect of interaction between cultivars and methods of cultivation on anthocyanin, phenol, firmness and weight of pulp per 100 berries. As shown, the interactions affect significantly in these parameters. Maximum value of anthocyanin (233.564 mg/100g) recorded in the interaction between Rash-miree cultivar and irrigated condition, whereas the minimum value (52.046 mg/100g) recorded in the interaction between Tre-rash cultivar with irrigated method. With regard to phenol content and weight of pulp of 100 berries, the highest values (343.217 mg/100g and 488.936 g) recorded from the interactions between Rash-miree cultivar with non- irrigated method. While the lowest values (313.685 mg/100g and 214.851g) for two parameters from the interactions (Tre-rash cultivar with non-irrigated, and Tre-rash cultivar with irrigated), respectively. On the other hand, the least berry firmness values (399.174 g) was observed from Rash-miree and non-irrigated cultivation method, while, the highest values (703.174 g) was recorded from the interactions between Tre-rash cultivars with non-irrigated cultivation method. These results disagree with obtained by [32] mentioned the berry firmness in the fruits of Rash-miree grape cv. was higher than Tre-rash grape cv., may be returning for the irrigation method reason.

Table (7): Effect of interactions between cultivars and cultivation methods on anthocyanin, phenol, firmness and weight of pulp per 100 berries

Cultivars	Cultivation method	Anthocyanin (mg/100 g)	Phenol (mg/100 g)	Firmness (g)	Weight of pulp/100 berry (g)
Rash-miree	irrigated	233.564 a	317.759 ab	456.785 c	450.524 b
	non-irrigated	191.048 b	343.217 a	399.174 c	488.936 a
Tre-rash	irrigated	52.046 d	317.886 ab	575.285 b	214.851 d
	non-irrigated	178.319 c	313.685 b	703.174 a	289.991 c

Contrariwise to some our results the previous researches show that irrigation enhances the quality of grape berries like weight and size, but the differences between the outcomes of these studies and our study may be return to some factors, the first, effects water on berry components are often contrasting, because of various irrigation quantities, and time of irrigations and environmental conditions, caused by differences in water availability [14, 54]. The second factor, such soil and plant characteristics, or even climatic factors, can affected on vine productivity also, berry development are intrinsically relate to temperature, irrespective of irrigate or not. [35, 11] researchers [45, 48] confirmed that decrease the water in a suitable range improves some berry quality. The third factor, grapevine is completely adapted to semi-arid climate, because it has deep and large root system also, have some physiological drought avoidance mechanisms, such as ability to adjust osmotically and effective stomatal control of transpiration that caused to use water as a perfect method [13]. The fourth factor the duration, severity and timing of the drought greatly impact the berry quality and there is evidence that the depression of berry yield and size is greater with pre-veraison stage water deficits [25] that mean in the water availability in the stage berry formation to lag phase effects on berry weight and size and in these stages the soil water availability was not arrived to a deficit stage (as shown in table 1 in May the rainfall about 13.4 mm and the humidity 41.4%). also, may be returning both cultivars were very adapted to rain-fed condition.

Finally, Grapevines have a great tendency to recompense, and as shown in (figure 7) the numbers of berries per cluster in non-irrigated method was lower than another method partially compensated by increased growth of the remaining berries in weight and size [27]. As well as, in table 2 the soil characteristics are very suitable for holding water.

The results indicated that cultivars have a different ability to survive under non-irrigated condition. The studies of under irrigation of some fruit production still unclear on their effect on yield and quality traits due to other factors related to environment, soil, heredity and adaptation. Based on the present study, it may be concluded that Rash-miree cultivar significantly superior Tre-rash cultivar regarding the berry diameter and length, Titratable acidity, weight and size of 100 berries, anthocyanin, weight of pulp per 100 berries. With respect to the cultivation methods of grapevine where registered the highest vitamin C, TSS, total sugar, pH, cluster weight, weight and size of 100 berries, anthocyanin and weight of pulp per 100 berries when cultivation in non-irrigated. Finally, the Rash-miree cultivar with non-irrigated cultivation showed significant superiority more the studied traits in our studied location.

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