
Impact of three pollinators on physicochemical characteristics of two table grape cultivars (*Vitis vinifera* L.) in Kurdistan Region, Iraq

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Abstract:

This study was carried out during 2021 growing season at the private rain-fed irrigated system vineyard on two cultivars of grapevine (Rashmiree and White Sadany) and chosen vines were 20 years old, and trained by head system a field experiment was located Shar-Bazher at Wazha village, Sulaimani Governorate, Kurdistan Region, Iraq, to investigate the impact of three different pollinators (Taify, Doshawy, and Trerash) as pollinators (pollen donors) and the control (self-pollination) vines provided no yield on some vegetative growth, yield and chemical characteristics of two grape cultivars. The effect of cultivars, Rashmiree obtained significant influence in (bunch weight, width, weight of 100 berries, and volume of 100 berries) characters, but Sadany gave only in maximum bunch width, in other properties there were nonsignificant differences between cultivars. The Bunch weight, Bunch length, bunch width, and the number of berries per bunch were high significant when Rashmiree cultivar pollinate with Trerash pollinator. While the T.S.S%, Total sugar, lowest in TA% and seeds per berry were high significant when Sadany cultivar pollinate with Trerash pollinator. Rashmiree cultivar gave high significant in TA%, and minimum in T.S.S%, total sugar, and number of seeds per berry when pollinated with Taify pollinator.

Keywords: Female grape cultivar, pollination, pollinator, yield, grape quality.

Introduction:

Grape is one of the most important horticultural crops in the world as well as in Iraq and the Kurdistan region. There are abundant grape cultivars and clones in the country (5). There are more than 70 cultivars of grapes grown in Kurdistan including dessert grapes, the varieties of Sadany and Rashmiree that can be used for table grape, production of raisin, juice, and wine. Kurdistan has the land suitable for grapes of the different varieties belonging to *Vitis vinifera*, known as the European grape (the grape of the old world), are the most widely grown grape in Iraq. Sadany and Rashmiree are the local grapevine cultivars. These cultivars are grown on a different scale in several separate areas on a small scale in Duhok in separate areas, Sulaymaniyah and Arbil governorates. The cluster is unregularly in shape, small or medium-size (4 and 2). Although it is generally regarded as a high-yielding cultivar, its production in some vineyards is highly erratic and displays significant changes over time. The ampelographic description of this cultivar reports the presence of morphologically hermaphrodite but functionally female flowers with reflexed stamens (15). Rely on the morphological inflorescences they

are dependent on allogamy cultivars that produce viable and functional pollen grains. For better fertilization rates, it is necessary to grow these cultivars close to suitable hermaphrodite varieties for better pollination (12).

Functionally female flower grapevine cultivar, intended for high-quality yield. While this cultivar is the functionally female flower, productivity is irregular because of the poorly fertilization (9). For grapevine cultivars that have a functionally female flower, it is characteristic that the pistil is well developed and functional, while the stamens are more or less reflexed and pollen is generally sterile (12). The problem of insufficient fertilization can appear in some grapevine cultivars with the hermaphrodite flower because of irregular ovule development (8 and 7). Knowing the relation of fertilization in grapevine cultivars, especially in cultivars functionally female flower has complex importance. The right assortment of pollinators in establishment vineyards enables high yields and good grape quality (15), but no previous information available about suitable pollinators or degree of compatibility with these cultivars.

This experiment was conducted between two functionally female grapevine varieties

to ascertain 1. Select suitable pollinators 2. Impact of pollinators quantitative on some quality and quantity characteristics of grapes cultivars.

Materials and Methods:

This research was conducted out during the growing season of 2021. Two grapevine cultivars (Rashmiree and white Sadany) were chosen for one area from the rain-fed irrigation system private vineyard. The vineyard was located in Shar-bazher at Wazha village 40 km Northwest of Sulaimani, the grove is located at 961 m above sea level with 35°73'943'' N latitude and 45°48'235'' E longitude.

The vines chosen were 20 years old, planted in silty-clay soil, spaced at 2 x 3 meters rows of grapevines, and watered with a rain-fed system. The vines were trained using a head system. The experimental vines were chosen to be as uniform as possible in vigor and similar in size. Winter pruning was proceeded on the 27 of February by leaving 32 eyes /vine on 8 spurs having 4 eyes each spur. The Randomized Complete Block Design was used to plan this experiment (3). Data were analyzed by using the experiment consisting of two female cultivars, three pollinators, and control (self-pollination) treatments with three replications; one individual vine for each experimental unit, so the numbers of vines used was 24 vines.

(Using a two-way analysis of variance (ANOVA). Data were analyzed by using XLSTAT program version 2.2 (17). All vines taken in this study received the same horticultural practices that are usually carried out in the vineyard. The date of fruit harvesting takes place when the berries attain the full-color stage and the T.S.S reached 16-17%. The chemical characteristics tests for all samples were done in the laboratory of Horticulture-College of Agricultural Engineering Sciences University of Sulaimani. Six clusters from each cultivar were harvested and immediately transported to the laboratory, the bunch and berries quality in terms of weight, length, width, and the number of seeds per berry, then kept in – 8 °C until chemical analysis.

Bagging the bunch:

Bagging six bunches for every replication for two cultivars (Sadany and Rashmiree) by paper bags before blooming. The inflorescence starts to grow in size with individual flowers becoming observable. A few days before blooming, the petals are easily detached from the receptacle, earlier it was difficult to tear them apart (16).

Cross-pollination:

When the blooming of inflorescences cultivar reached %95-100, With ready pollen grains that were collected earlier from the pollinators hermaphrodite

grapevine in the same vineyard and drying the pollen grains at room temperature after that storing in the refrigerator at -4 °C to protect the rate of the viability of pollen grains, also at the time transferred for the field experiment stayed in a cool condition box.

The cross-pollination was done by storing pollen grains with a soft paintbrush, by using a special paintbrush for each

treatment. Sterilized the brush and my hands with 70% ethanol between pollinations. After pollen is thoroughly applied to a cluster, take care to brush every flower, the paper bag was closed again to prevent fertilization by other pollen sources, and to protect the developing fruit from birds and the elements.

Meteorological data of the location during the study period 2021

Month	2020				2021			
	Rainfall I (mm)	Air temperature (°C)			Rainfall II (mm)	Air temperature (°C)		
		Avg.	Max.	Min.		Avg.	Max.	Min.
January	124.0	0.0	2.4	-2.5	124	-0.5	2.6	-3.7
February	242	-0.7	4.1	-5.2	170	3.6	6	1.2
March	270	6.9	11.3	2.5	34	5.3	8.3	2.2
April	94	9.8	12	6.3	26	11.1	14.9	10.5
May	31.5	16.3	21	11.6	0	20.0	25.3	14.7
June	0.0	23.8	30.8	16.8	0	23.4	29.8	17.1
July	0.0	24	32.2	15.9	0	28.2	33.0	23.5
August	0.0	23.4	29.7	17.1	0	26.85	30.9	22.8
September	0.0	22.9	25.9	19.8	0	23.8	26.8	20.8
October	0.0	16.6	20.1	13.1	9.5	13.9	18	9.8
November	343.5	8.3	11.1	5.6	37.5	6.8	9.8	3.9
December	36	2.0	4.5	-0.6	173.5	4.7	6.4	3.0
Total/ average	1141	13.5 3	17.09	6.97	538.5	12.76	17.65	10.48

Data collected from (Chwarta _Agro_ meteorological station) at Sulaimani city, the nearest station to the research location.

Parameters measurements:

Yield and components:

1. Bunch weight (g): By using an electronic balance.
2. Bunch length and maximum width by using measuring ruler.
3. Weight of 100 berries (g): By using an electronic balance.
4. Size of 100 berries (cm³): By using a graduated cylinder containing water to determine the berries by water displacement.
5. Number of berries per bunch by counting.
6. Number of seeds per berry.

Chemical characteristics of the Berries:

1. Total soluble solids were measured by Hand Refractometer (LCD DIGITAL BENCH MODEL). A drop of the berry juice was placed on the prism of the digital Refractometer (1).
2. Total sugar (%): Total sugars were estimated berry juice by Lane and Eynon method as described in (10).
3. Acidity was determined in berry juice by titration with (0.1N) NaOH using phenolphthalein as an indicator, the acidity was determined as tartaric acid calculation (g.100⁻¹ ml juice) (1).

Results and Discussion:

Bunch weight (g): Present data in the table (1) explain the effect of pollinators,

cultivars, and their interaction on bunch weight (g).

Effect of pollinators: As shown in the table (1) Trerash gave the highest value bunch weight (261.565 g) and self-pollination obtained the minimum bunch weight (0.000 g) while among the pollinators Doshawy recorded the least value bunch weight (120.404 g).

Effect of cultivars: Significant differences were presented between Sadany and Rashmiree cultivars due to the character bunch weight, which produced (140.270 g) and (163.266 g) respectively.

The interaction between pollinators and cultivars: The same table shows that the highest significant interaction between Trerash and Rashmiree for bunch weight (316.265 g) and the lowest significant interaction for self-pollination (0.000). However, Doshawy and Rashmiree had the lowest interaction for bunch weight (102.699 g). These results were in a good agreement with previous workers (15 and 14).

According to the same table, the highest significant interaction between Trerash and Rashmiree for bunch weight (316.265 g) and the lowest significant interaction in self-pollination (0.000). However, Doshawy and Rashmiree have the lowest interaction for bunch weight (102.699 g). After fruit set, self-pollinated inflorescences appeared completely

dehydrated. These results are similar to those reported on another grapevine cultivar featuring flowers with reflexed stamens (Malbo Gentile) (6).

Previous research has shown that these cultivars are functionally female based on flower morphology, and because they are self-sterile, they require cross-pollination by other pollinators (4 and 2). But, in this research practically proved both cultivars Sadany and Rashmiree hadn't any fruit set.

There for the minimum interaction result for each pollinator with cultivars was more than the self-pollination. After this parameter, we don't compare the value of self-pollination with the pollinator's value. Only, indicate the results of pollinators and their interaction with cultivars. As the results obtained in Cultivar Grk bijeli possesses morphologically hermaphrodite flowers studied by (15).

Table 1. Effect of pollinators, cultivars and their interactions on bunch weight of grapevine, Sadany and Rashmiree (g)

Cultivar	Self pollination	Pollinators			Effect of Cultivar
		Taify	Doshawy	Trerash	
Sadany	0.000 f	216.108 bc	138.109 d	206.865 c	140.270 b
Rashmiree	0.000 f	234.099 b	102.699 e	316.265 a	163.266 a
Effect of pollinator	0.000 d	225.104 b	120.404 c	261.565 a	

Means with the same letter for each factor and interactions are not significantly different at 5% level based on Duncan's Multiple Range Test

Bunch length:

Effect of pollinators: it is clearly shown in the table (2) that Trerash obtained the significantly highest bunch length (21.833 cm). The lowest value was recorded by Doshawy (17.875 cm).

Effect of cultivars: nonsignificant differences were found between cultivars Sadany and Rashmiree in bunch length in the same table.

The interaction between pollinators and cultivars: Data present in the table (2)

confirm the presence significant interaction effect between pollinators and cultivars. The association between pollinator Trerash with cultivar Rashmiree recorded maximum bunch length reached (23.000 cm), while the interaction between Doshawy and Rashmiree recording (17.333 cm). may be due to the effect of the pollen source. A similar investigation was indicated by (14).

Table 2. Effect of pollinators, cultivars and their interactions on bunch length of grapevine, Sadany and Rashmiree (cm)

Cultivar	Self pollination	Pollinators			Effect of Cultivar
		Taify	Doshawy	Trerash	
Sadany	0.000 d	20.917 ab	18.417 bc	20.666 abc	15.000 a
Rashmiree	0.000 d	19.333 bc	17.333 c	23.000 a	14.917 a
Effect of pollinator	0.000 c	20.125 ab	17.875 b	21.833 a	

Means with the same letter for each factor and interactions are not significantly different at 5% level based on Duncan's Multiple Range Test.

Maximum Bunch width (cm):

Effect of pollinators: Significant effect was recorded between pollinators due to maximum bunch width character. Trerash recorded a maximum bunch width value reached (10.764cm), while the Doshawy recorded a minimum bunch width value of (7.762cm).

Effect of cultivars: Significant effect of cultivars was recorded in this character. Sadany cultivar exceeded Rashmiree cultivar in this character, they produced (7.882 cm) and (6.298 cm) respectively in maximum bunch width.

Effect of pollinators, cultivars, and their interactions: The character of maximum bunch width showed a significant response to the interaction between pollinators and female cultivars. Extreme bunch width was documented when Trerash pollinators interacted with Sadany female cultivar (11.444 cm), while the lowest number was produced when Doshawy pollinator interacted with Rashmiree recording (5.857 cm). As like bunch length maybe effected by pollen donor efficiency on the maximum bunch. Similar to the investigation by (14).

Table 3. Effect of pollinators, cultivars and their interactions on maximum bunch width of grapevine, Sadany and Rashmiree (cm)

Cultivar	Self pollination	Pollinators			Effect of Cultivar
		Taify	Doshawy	Trerash	
Sadany	0.000 d	10.417 ab	9.667 ab	11.444 a	7.882 a
Rashmiree	0.000 d	9.250 b	5.857 c	10.083 ab	6.298 b

Effect of pollinator	0.000 c	9.833 a	7.762 b	10.764 a
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Means with the same letter for each factor and interactions are not significantly different at the 5% level based on Duncan's Multiple Range Test.

The number of berries per bunch (berries/bunch):

Effect of pollinators: Table (4) illustrates data associated with berry per bunch, there is a significant difference between the effects of pollinator. Berries per bunch responded significantly to Trerash, and gave maximum berries per bunch (80.569). The minimum berries per bunch was recorded by Doshawy (40.708).

Effect of cultivars: According to the same table nonsignificant differences were recorded between cultivars.

The effect of pollinators, cultivars, and their interaction: Berries per bunch responded significantly to the interaction between pollinators with cultivars. The interaction Trerash and Rashmiree showed a maximum berries/bunch (101.583), while the lowest berries/bunch (32.917 berries/bunch) was recorded by the interaction same cultivar with Doshawy. The results may be as influenced of used different pollinators. As the results indicated by (11).

Table 4. Effect of pollinators, cultivars and their interactions on the number of berries per bunch of grapevines, Sadany and Rashmiree (berries/Bunch)

Cultivar	Self pollination	Pollinators			Effect of Cultivar
		Taify	Doshawy	Trerash	
Sadany	0.000 e	74.083 b	48.500 c	59.555 c	45.535 a
Rashmiree	0.000 e	54.000 c	32.917 d	101.583 a	47.125 a
Effect of pollinator	0.000 d	64.042 b	40.708 c	80.569 a	

Means with the same letter for each factor and interactions are not significantly different at 5% level based on Duncan's Multiple Range Test.

Weight of 100 berries (g):

Effect of pollinators: As shown in table (5) significant differences were recorded between pollinators for the weight of 100 berries. Taify pollinator obtained the maximum weight of 100 berries (374.173

g), but Doshawy pollinator gave the least value of the weight of 100 berries (282.592 g).

Effect of cultivars: As presented in the same table high significant between cultivars in weight of 100 berries.

Rashmiree cultivar was superior to other cultivars in terms of weight of 100 berries. Where recorded the highest values (266.218 g), while Sadany recorded a lower value (227.816 g).

Effect of pollinators, cultivars, and their interaction: table (5) shows significantly

high weight of 100 berries with interaction between Taify and Rashmiree (458.223 gm) while the lowest weight was for interaction between Doshawy with Sadany (271.267 gm). The same result was reported previously by (11).

Table 5. Effect of pollinators, cultivars and their interactions on the weight of 100 berries of grapevine, Sadany and Rashmiree (g)

Cultivar	Self pollination	Pollinators			Effect of Cultivar
		Taify	Doshawy	Trerash	
Sadany	0.000 e	290.123 cd	271.267 d	349.873 b	227.816 b
Rashmiree	0.000 e	458.223 a	293.917 cd	312.733 c	266.218 a
Effect of pollinator	0.000 d	374.173 a	283.592 c	331.303 b	

Means with the same letter for each factor and interactions are not significantly different at the 5% level based on Duncan's Multiple Range Test.

The volume of 100 berries (cm³):

Effect of pollinators: From table (6) significant effects of pollinators was recorded due to the character volume of 100 berries, confirming the superiority of Taify pollinator compared to Doshawy recording the lower rate of volume of 100 berries (368.333 and 278.667 cm³) respectively.

Effect of cultivars: As shows in table (6) different cultivars significantly affected the volume of 100 berries. The highest value (264,583 cm³) was recorded by Rashmiree.

While the lowest value (223.333 cm³) was obtained by Sadany cultivar.

Effect of pollinators, cultivars, and their interactions: For the interaction between the studied factors, Data in the table (6) show that the interaction between Taify and Rashmiree had a significant impact on the volume of 100 berries and gave the highest value which was (450.000 cm³) while the lowest value (260.000 cm³) was recorded from the interaction between Doshawy and Sadany.

Table 6. Effect of pollinators, cultivars and their interactions on the volume of 100 berries of grapevine, Sadany and Rashmiree (cm³)

Cultivar	Self pollination	Pollinators			Effect of Cultivar
		Taify	Doshawy	Trerash	
Sadany	0.000 e	286.667 cd	260.000 d	346.667 b	223.333 b
Rashmiree	0.000 e	450.000 a	297.333 cd	311.000 bc	264,583 a
Effect of pollinator	0.000 d	368.333 a	278.667 c	328.833 b	

Means with the same letter for each factor and interactions are not significantly different at the 5% level based on Duncan's Multiple Range Test.

The number of seeds per berry (seeds/berry):

Effect pollinators: A significant response in number of seeds per berry was calculated as a result of pollinators. The highest number of seeds per berry was reported by Doshawy (3.133), while the lowest number of seeds per berry was recorded by Taify pollinators (2.083).

Effect of cultivars: nonsignificant differences between Sadany and Rashmiree cultivars were estimated due to the number of seeds per berry.

Effect of pollinators, cultivars, and their interactions: Concerning the interaction

between the study factors, Data in the table (7) shows that pollinators and cultivars exposed significant impact seeds per berry. Results indicated that the highest number of seeds per berry was obtained from the interaction of Doshawy with Rashmiree which significantly surpass (3.200), that the least (2.033) was obtained from the interaction Taify and Rashmiree. The differences between the combinations of pollinator's cultivar due to this character may be due to difference in compatibility between pollinators and cultivars. Similar results were reported previously (9).

Table 7. Effect of pollinators, cultivars and their interactions on the number of seeds per berry of grapevine, Sadany and Rashmiree (seeds/berry)

Cultivar	Self pollination	Pollinators			Effect of Cultivar
		Taify	Doshawy	Trerash	
Sadany	0.000 c	2.133 b	3.067 a	2.200 b	1.850 a

Rashmiree	0.000 c	2.033 b	3.200 a	2.200 b	1.858 a
Effect of pollinator	0.000 c	2.083 b	3.133 a	2.200 b	

Means with the same letter for each factor and interactions are not significantly different at the 5% level based on Duncan's Multiple Range Test.

Total Soluble Solid (T.S.S %):

Effect of pollinator: Significant effects of pollinators in T.S.S% were observed in the table (8). Trerash at veraison gave a maximum T.S.S of (17.633 %), but the grapevine pollinated by Taify recorded the lowest T.S.S with (15.800 %), because of regulating nutrient accumulation at the third stage of berry growth.

Effect of cultivars: nonsignificant differences appeared between cultivars in T.S.S % (table 8).

Effect of pollinators, cultivars, and their interactions: Significant interaction effect

was noticed from the same table confirming that the interaction between Trerash pollinator with Sadany cultivar at version recorded maximum T.S.S % reached (19.100 %), while the interaction between Taify pollinator with Rashmiree cultivar at recorded the lowest value (15.367 %). The major variations emerging from the interplay of the research parameters might be attributed to the pollinators' collective influence. Similar consequences testified previously (14).

Table 8. Effect of pollinators, cultivars and their interactions on total Soluble Solid of grapevine, Sadany and Rashmiree (T.S.S %)

Cultivar	Self pollination	Pollinators			Effect of Cultivar
		Taify	Doshawy	Trerash	
Sadany	0.000 c	16.233 b	15.767 b	19.100 a	12.775 a
Rashmiree	0.000 c	15.367 b	18.333 a	16.167 b	12.467 a
Effect of pollinator	0.000 c	15.800 b	17.050 a	17.633 a	

Means with the same letter for each factor and interactions are not significantly different at 5% level based on Duncan's Multiple Range Test.

Total Acidity (%):

Effect of pollinators: This table represents significant effects of pollinators were recorded in the character total acidity percentage, Taify as pollinator was significantly the higher value for total acidity % (1.100%) while the lower was for Trerash (0.675%).

Effect of cultivar: Table (9) shows that there were nonsignificant differences between cultivars in total acidity %.

Effect of pollinators, cultivars, and their interactions: Significant interaction effect was recorded between pollinators and cultivars due to total acidity percentage.

The interaction between Taify and Rashmiree recorded maximum content of TA% when reached (1.200 %), while the interaction between pollinated Rashmiree cultivar by Doshawy pollinator at veraison recorded the lowest total acidity content reached (0.550 %). Because the highest differences between pollinators and nonsignificant varied between cultivars while, exceeding and decreasing in the combination treatments maybe effect pollen donors on TA%. These results were in good agreement with the previous worker (14).

Table 9. Effect of pollinators, cultivars and their interactions on total Acidity of grapevine, Sadany and Rashmiree (TA %)

Cultivar	Self pollination	Pollinators			Effect of Cultivar
		Taify	Doshawy	Trerash	
Sadany	0.000 d	1.000 ab	1.200 a	0.550 c	0.688 a
Rashmiree	0.000 d	1.200 a	0.550 c	0.800 b	0.638 a
Effect of pollinator	0.000 d	1.100 a	0.875 b	0.675 c	

Means with the same letter for each factor and interactions are not significantly different at 5% level based on Duncan's Multiple Range Test.

Total Sugar (%):

Data in table (10) explains the effect of pollinators, cultivars, and their interaction due to total sugar %.

Effect of pollinators: As shown in table (10) Trerash pollinator exceeded significantly the Taify pollinator in total sugar % (16.923 and 14.957) respectively.

Effect of cultivars: nonsignificant variances between the grapevine female cultivars in total sugar % table (10).

Effect of pollinators, cultivars, and their interactions: The interaction effect between

pollinators and cultivars in the percentage of sugar was significant, Rashmifree pollinated by Doshawy produced maximum total sugar % with (18.552 %), while the interaction between the pollinated Sadany by the same pollinator at veraison recorded the lowest percentage of sugar with (13.434 %). This efficient variety may be a returned to the influence of pollinators by accumulation of sugar in cultivars. Similarly, the results on seven cultivars of grapevine were chosen in one location studied by (13).

Table 10. Effect of pollinators, cultivars and their interactions on total sugar of grapevine, Sadany and Rashmiree (%)

Cultivar	Self pollination	Pollinators			Effect of Cultivar
		Taify	Doshawy	Trerash	
Sadany	0.000 d	15.860 b	13.434 c	18.207 a	16.410 a
Rashmiree	0.000 d	13.655 c	18.552 a	15.640 b	17.060 a
Effect of pollinator	0.000 d	14.757 c	15.943 b	16.923 a	

Means with the same letter for each factor and interactions are not significantly different at 5% level based on Duncan's Multiple Range Test.

Conclusion:

This research showed that both cultivars (Sadany and Rashmiree) in self-pollination provided zero yields, may be the pollen grains could not germination nor have self-incompatibility, they were Functionally female, and consequently could not bear any yield if planted in a vineyard far from the suitable hermaphrodite grapevine cultivars. The results of the effect of

cultivars illustrated the statistical difference in (bunch weight, maximum bunch width, weight of 100 berries, and volume of 100 berries) characters, Sadany was superior only in maximum bunch width, that is may be returned to the impact of cultivar because Sadany normally has loosely bunch character, in other properties Rashmiree obtained the highest value, that is may be returned to the Rashmiree property therefor typically

has big berry volume and more weight single berry. But there were nonsignificant differences between cultivars in characters of (bunch length, number of berries per bunch, number of seeds per berry, T.S.S%, TA%, and Total sugar). Pollinators had a significant influence on the physical and chemical of the grape bunch and berry characteristics. Trerash recorded the highest bunch weight, and the number of berries per bunch, followed by Taify, and the lowest obtained by Doshawy. Both Trerash and Taify were the biggest in bunch length and bunch width on the other hand smallest in the number of seeds per berry but Doshawy recorded a minimum in bunch length and bunch width and the maximum number of seeds per berry.

According to the results, Taify presented a high significant value due to the weight and volume of 100 followed by Trerash while Doshawy gave the lowest. Trerash recorded the highest T.S.S% and Total sugar but the lowest TA%. After that Doshawy com. but Taify obtained maximum TA% with minimum T.S.S% and Total sugar. Rely on the physical and chemical properties illustrated in statistical results, to get high production grape yield and marketing quality, Trerash is the best suitable hermaphrodite pollinator when establishing a new vineyard or renewing the old vineyards for both local grapevine cultivars. Afterward, Taify is a second

appropriate hermaphrodite grapevine source of donor pollen grains, although it is high in value TA% with minimum T.S.S% and Total sugar. But that is maybe associated with the weather condition that is illustrated in the metrological data, the increased air temperature in the growth and development of berries after verasion to ripening stage cause reduction in the accumulation of sugar or maybe it did not reach the optimal ripening stage need more days by the effect pollinator. Doshawy pollinator came as the third level in suitability for cultivars in associated yield properties. we recommended use other well-known hermaphrodite grapevine pollinators, Sadany and Rahmiree, pollinate in various locations, or pollination other functionally female grapevine cultivar with Taify, Doshawy and Trerash.

Conflict of interest

The authors have no conflict of interest.

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