3

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Effect of Rice Straw Mulchingon Water Use Efficiency, Growth, Yield and Quality of King Ruby Grape under Surface Irrigation

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NEW agriculture practices are required for developing water use efficiency. Mulching as a target for that goalhas not been adequately quantified. The aim of this work was to clarify the role of rice straw mulchingin reserving water under surface irrigation and quantify its application benefits on yield and quality of king ruby grape vineyard grown in Delta Nile of Egypt during 2017 and 2018 seasons. The experimental layout included six treatments T1, T3 and T5 for three irrigation regimes which introduced control or zero, 25% and 50% of restriction irrigation water. T2, T4 and T6 introduced the mulching application within the previous irrigation regimes. The irrigation regime started at veraison phase (pre maturity stage) from May 2017 till end of July (time of harvest) and straw mulches were applied at rate 5 kg/m^2, and it was renewed in 2018 season. Soilbulk density (BD), infiltration rate (IR) and NPK uptake were looked up. Growth and qualities attributes were figured out as a reflection affect by treatments under investigations. Results highlighted the role of mulching in keeping soil moisture under severe drought stress, 50% of restriction irrigation water (T6) similar to unstressed, control (T1) subsequently the most measured parameter of soil, growth and quality were similar in both treatments. These findings suggest the application of T6 (50% of restriction irrigation water) treatment as a target recommendation for saving 50 % of irrigation water without yield reduction and with good qualities.

Keywords: King ruby cultivar, Ricestraw, Mulching, Water use efficiency, Surface irrigation, Yield, Quality.

Introduction

Grape (*Vitisvinifera* L) is one of the most important fruits worldwide for not only fresh consumption but also for raisins and juice making. In Egypt, grape is the second major fruit crop after citrus. Ruby Seedless cultivar takes special attention as table grapes in local and export markets. Good qualities that include a combination of medium size cluster with uniform colored berries beside pleasant flavor and texture are always of interest. Increasing the amount of water led to negative impacts on grapes qualities (Valdés et al., 2009 and Basileet al. 2011). Many studies worldwide have been showed thatgrapevine water deficit reflected reduction ofcanopydevelopment, yield andchanging composition of fruits (Bravdo et al., 1985, Matthews & Anderson, 1989, Kennedy et al., 2002, Robyet al., 2004, Castellarinet al., 2007, Bindonet al., 2008 and Pellegrino et al. 2014). However, deficit irrigation throughout the growing season led to enhanced colors and quality of red grapes (Williams and Matthews, 1990, Santos et al., 2007). Furthermore, Deluc et al. (2009) found that water deficit promote sugar accumulation due to the inhibition of lateral shoot growth which lead to reallocation of carbohydrates to the fruits, or may due to the direct effect of ABA-mediated uptake of hexoses.Ginestar et al. (1998) found that reduction in berry sugar accumulation was related to the reduction in photosynthesis rate. Imposing water deficit early in the start season is resulting inhibition of vegetative growth and berry size (McCarthy et al., 2002). However, the imposing water deficit after veraison may enhance anthocyanin accumulation (Dry et al., 2001). Numerous benefits of mulching were reported by several studies including the increase of nitrogen and other nutrients in soils due to the inhibition of leaching and evaporation (Agnew et al., 2002

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& 2005, Ross, 2010 and Nguyen et al., 2013). Moreover,the inhibition in weed germination subsequently reduction in herbicide applications as related to mulching were reported (Elmore et al., 1998, Frederikson et al., 2011 and Steinmaus et al., 2008). In addition, mulching found to be useful for soil characteristics (Agnew et al., 2002, Göblyöset al., 2011 and Némethy, 2004). On the other hand, mulching increase water use efficiency were reduced the water evaporation from soilsurfaces (Gregory, 2004 and Davies et al., 2011). Agnew et al. (2002) found that soil moisture increased 5 % in the upper part of the soil profile (0–30 cm) and 3.4% in soil profile between (30-60) under mulching compared to till one. Zhang et al. (2014) reported that rice straw mulching increase water use efficiency and the yield of grapevines.Moreover, straw mulching increased water use efficiency by saving 30% of irrigation water (Chaudhryet al., 2004, Zhang et al., 2005 and Laila & Ali 2011). In addition, Chan et al., (2010) found that composted mulch were lead to 30% increase of saving irrigation water used in vineyard.Two aims of this study were followed, the first is to reserve the amount of water used in irrigation and the second is to improve the production and the quality of King Ruby grape cultivar.

Material and Methods

Research site

Field experiments were conducted during 2017 and 2018 seasons in a 4-years-old vineyard of *Vitisvinifera* 'king ruby'on own roots with planting space of 3 m between rows and 2 m within rows resulting density of 700 vines/ feddan in private farm located in Abou El-Ghar village, Kafr El-Zayat, Gharbiya governorate, Egypt. Before the start of the experiment soil characteristics were figure out as shown in Table 1.

TABLE 1. Orchard Soil characteristics of vineyard King ruby cultivar at the start of the experiment.

Soildepth cm	Particle size distribution %			pH	EC dS m^{-1}	O.M g Kg^{-}	Available NPK mg Kg^{-1}		
	Clay	Silt	Sand				N	P	K
0-30	46.21	23.27	31.42	8.24	2.21	11.56	49.12	4.14	197.56
30-60	43.14	21.25	30.32	8.21	2.25	11.35	47.36	4.05	191.23
60-90	44.78	22.54	31.24	8.26	2.23	11.21	45.75	3.89	195.35

Vines were trained according to Spanish Barron trellis and arms were positioned upwards in four directions. Before the start season, vines were pruned to 12 cansdistributed on the four arms. When cluster reached around 10 cm length, the crop load was normalized to 25 bunches per plant. Vines under investigation were received normal agriculture practices inclusive fertilization, pests and diseases control.

The experiment layout

The experiment started at veraison phase (pre mature stage) from May till end of July (time of harvest). The experiment consists of six treatments each had three replicates inclusive three vines for each which introduced T1, T3 and T5 for three irrigation regimes, control or zero, 25% and 50% of restriction irrigation water *i.e.* (70.09%, 60.37% and 55.54% soil moisture as a percent of field capacity), respectively. T2, T4 and T6 introduced the mulching application within the previous irrigation regimes.The trail arranged in a complete randomize block design represents three irrigation regimes (zero, moderate and severe drought stress, respectively) including rice straw mulching treatments within them as follow and shown in Fig. 1. The straw mulches were applied in the start of May 2017 at rate 5 kg/m^2, and it was renewed in 2018.

T1:irrigation regime with 10 days intervals, 70.09% soil moisture as a percent of field capacity
T2:same irrigation regime of T1 with rice straw mulching
T3: 25% of restriction irrigation water, 15 days intervals, 60.37% soil moisture of field capacity
T4: same irrigation regime of T3 with rice straw mulching
T5: 50% of restriction irrigation water, 20 days intervals, 55.54%soil moisture of field capacity
T6: same irrigation regime of T4 with rice straw mulching

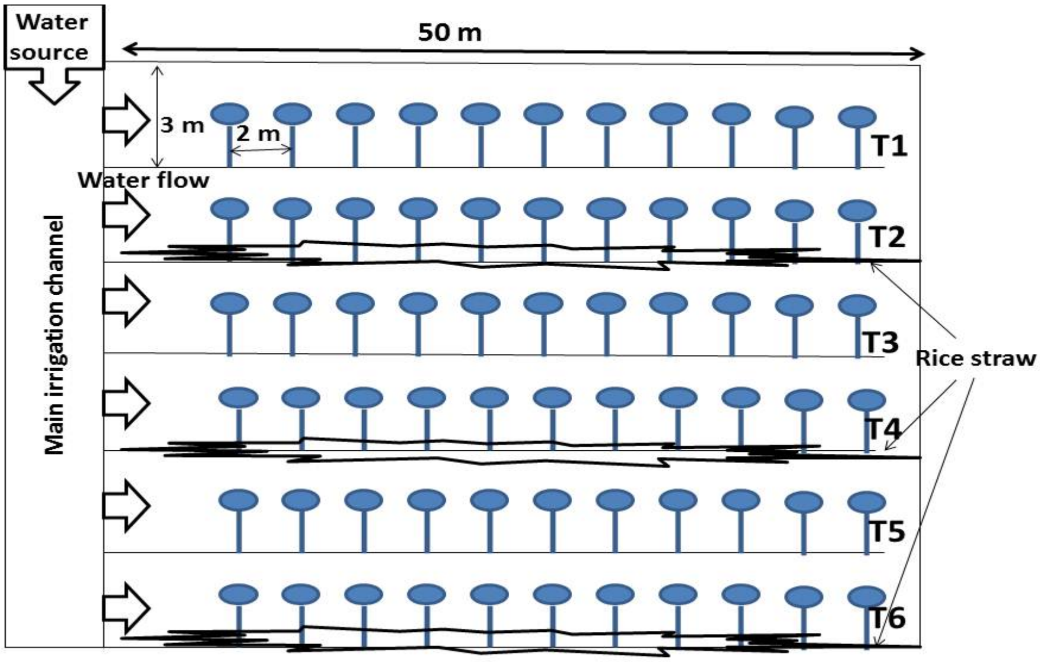

Fig. 1. the layout of the field experimental design, T1 and T2 refers to zero drought stress without and with rice straw over the ground, respectively. T3 and T4 refer to moderate drought stress. T5 and T6 refer to the severe drought stress.

Soil attributes

The soil samples from the surface layer (0 to 30 cm) and a medium (30 to 60 cm) were collected. Micro-kjeldehl method as described by (page, 1982) was used for nitrogen determination, Cotteine*et al.*, (1982) was followed for Phosphorus and Flame photometer was used for Potassium (K) according Jackson (1967).Bulk density (BD) was measured using the core method (Grossman and Reinsch, 2002) and Infiltration rate(IR)was determined by using double ring with applying 15 cm depth of water. Then, the infiltration time were recorded for each plot. After that, the average of thesevalues was calculated for each treatment. Basic infiltration rate (IR) was calculated using the equation ofKostiakov(1932) as follows:

$$IR = KT^n$$

Where, IR is the cumulative infiltration after time T, T= Time after infiltration starts, K and n are constants that depend on the soil and initial conditions (evaluated from measured infiltration data. K and n values range between zero to 1.

Available water (AW)was calculated according Klute (1986) by subtracting permanent wilting point (-1500 kpa) from field capacity (-33kpa) as follow:

$$AW = FC - WP$$

Where, FC is the water content at field capacity, WP is the water content at permanent wilting point.

Some vegetative growth measurements

These measurements were taken one month later of the start of the experiment, shoot length measured by cm, single leaf area was measured using the fifth leaf from the shoot tip using the device meter model CI 203, USA, then multiplied by the average number of leaves/shoot and then multiplied by number of shoots/vine. *Bud burst %* was calculated at the following season of the experiment according to the following equation:

$$\text{Bud Burst \%} = \frac{\text{(Number of brusted buds/vine)}}{\text{(Total number of buds left/vine (40))}} \times 100$$

Some yield indicators

Yield calculated by average cluster weight multiplied by number of cluster/vine and Bud fertility % was calculated according to Omran (2000) as the following equation:

$$\text{Bud fertility \%} = \frac{\text{(Number of clusters/vine)}}{\text{(Total number of buds left/vine (40))}} \times 100$$

Some Fruit physical and chemical measurements

Average cluster length and width, berry length and width, and volume juice of 100 berries were determined.Harvest was done at the level of TSS of 16-17% according to Hamza (2013). Total sugars, anthocyanins and acidity in juice were followed according (A.O.A.C., 2000). Hand refractometer was used to determine total soluble solids (TSS) as Brix.

Total chlorophyll and carbohydrate

Leaf total chlorophyll (mg g FW^{-1}) was determined according to Von-Wettstein (1957). Total carbohydrates in the canes (%) were determined according to Hedge and Hofreiter (1962).

Petiole content

Same method for NPK determinations were used as mentioned in soil analysis part. Calcium was measured using atomic absorption spectrophotometer Perkin Elmer-3300 according chapman and Pratt (1961).Magnesium (Mg) was determined according to Wilde et al. (1985).

Statistical analysis

Data were analyzed by Statistical Graphics Corporation, STATGRAPHICS Plus (St. Louis, MO, USA) for one way analysis of variance and employing Duncan's multiple range tests (Duncan, 1955) at the 0.05 confidence level and for principle component analysis (PCA).

Results and Discussion

Soilattributes

The mean results of soil analysis revealed that soil moisture as a percent of field capacity was significantly raised from 70.09 % in T1 to 78.28 % in T2, also from 60.37 % in T3 to 69.97 % in T4 and from 55.54 % in T5 to 63.98 % in T6.

The effects of the experimental treatments on soil proprieties were illustrated in Table 2. The infiltration rate (IR) represents the ability of soil in water- solute transportation (Reynolds et al., 2000 and Carter et al., 2004). Results in Table 2 showed that highest IRwas found in T2 treatment (rice straw cover without any restriction of irrigation water, or mulching control) flowed by T4 (rice straw cover under 25% of restriction irrigation water), then flowed by T6 (rice straw cover under 50% of restriction irrigation water). The IRin T6 was similar to T1 (control treatment or the normal irrigation regime without any restriction of irrigation water in the absent of rice straw cover). The lowest results of IRwere found in T5 and T3 (under 50% and 25% of restriction irrigation water in the absent of rice straw cover, respectively).

T1 (control),T2 (mulch control), T3 (25% of restriction irrigation water), T4 (25% of restriction irrigation water with mulching), T5 (50% of restriction irrigation water), T6 (50% of restriction

TABLE 2. The effect of rice straw mulching and the restriction of irrigation water on soil infiltration rate (IR), soilbulk density (BD), soil available water (AW) and soil content of NPK in the trail field of king ruby grape during 2017and 2018 seasons.

Parameters	IR cm. h^{-1}		BD g cm^{-3}		AW %		N mg Kg^{-1}		P mg Kg^{-1}		K mg Kg^{-1}	
Treatments	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
T1	0.89c	0.87c	1.48 c	1.49c	20.21c	20.22c	45.66c	45.68c	4.65c	4.67c	202.23c	202.21c
T2	1.04e	1.03e	1.35a	1.35a	22.51d	22.53d	48.56e	48.52e	5.75e	5.74e	211.15e	211.21e
T3	0.81b	0.79b	1.56d	1.55d	18.14b	18.23b	43.66b	43.36b	4.35b	4.28b	198.12b	198.24b
T4	0.96d	0.98d	1.39b	1.40b	20.21c	20.22c	48.52e	48.55e	5.74 e	5.73 e	210.83 e	210.90 e
T5	0.77a	0.75a	1.67e	1.66e	16.56a	16.67a	41.52a	41.25a	4.11a	4.09a	195.25a	195.27a
T6	0.88 c	0.86c	1.48c	1.49c	19.67c	19.65c	47.12d	47.23d	5.11d	5.13d	205.11d	205.27d

T1 (control),T2 (mulch control), T3 (25% of restriction irrigation water), T4 (25% of restriction irrigation water with mulching), T5 (50% of restriction irrigation water), T6 (50% of restriction irrigation water with mulching), Nitrogen (N), Phosphorus (P), Potassium (K), Means followed by the same letter are not statistically different by Duncan at 0.05 levels.

irrigation water with mulching), Nitrogen (N), Phosphorus (P), Potassium (K), Means followed by the same letter are not statistically different by Duncan at 0.05 levels.

Bulk density (BD) of the soil considered an indicator for improving soil porosity, subsequently aeration according to (Jones et al., 2003). The results of BD in Table 2 revealed that mulching were reduced BD but this reduction were gradually lost at both of restriction irrigation water. Available water (AW) measure the ability of the soil in holding water. The results of AW in Table 2 were found similar to the results of the infiltration rate (IR) as well. The results of soil content of NPK were similar to the results of the infiltration rate (IR) too as shown in Table 2. These findings are closeconformity with the previous results of (Agnew et al., 2002, Göblyöset al., 2011, Némethy 2004 and Zhang et al., 2014) who reported that mulching are leading to increase of soil moisture retention (available water) enabling a reduction in irrigation, increase of nutrient release subsequently a reduction in fertilizer application, increase of infiltration rate and decrease of bulk density.

Some vegetative growth measurements

Results in Table 3 showed that mulching in restriction irrigation water (T6) kept soil moister in optimal order which keptshoot length, leaf surface and bud burst equal to that measured under normal irrigation regime (T1, control). However, the same parameters showed significantly higher results in T2 and T4 treatments, Table 3On the other hand, absence of mulching in drought stressed vines as in T3 and T5 gave the lowest value Table 3. These results are in accordance with those obtained by (Agnew et al., 2002 & 2005, Ross 2010 and Nguyen et al., 2013) who found that mulches improved vines shoot length and leaf surface area inbud burst under drought conditions. Other supporting findings reported by McCarthy et al. (2002) showed that early imposing water deficit resulting inhibition of vegetative growth. More conformity results by Ginestar et al. (1998) who stated that excess water content inhibit photosynthesis subsequently reduce total chlorophyll content.Too much soil water content may contribute to excess vine growth (Hamman & Dami 2000 and Smart, 1985) but excess vegetative growth generates self-shading leading to a lack of vine balance (Wheeler et al., 2008).

Yield indicators

Results of yield revealed that T6 treatment had similar results to T1 treatment(control) and T3 treatment without significant differences between them, Table 4.T5 treatment showed the lowest yield followed by T2 and T4, respectively, Table 4. Results of bud fertility showed no significant differences betweenT6 and T1 treatments Table4. The lowest bud fertility recorded in T5 then T3, T4 and T2, respectively, Table 4. These results are in line with findings from (Valdés et al., 2009 and Basile et al., 2011) who found that excess of water content did not improve grapes yield and berries qualities. Other results are in accordance obtained Chan et al. (2010) found that composted mulch under restriction irrigation regime in vineyard lead to the increase of yield and quality.

Some fruit physical and chemical measurements

It is clear that results of T6 treatment showed no significant differences compared to results of T1 treatment (control) and T3 concerning cluster

TABLE 3. The effect of rice straw mulching and the restriction of irrigation water on shoot length, leaf surface area and bud burst in the trail field of king ruby grape during 2017 and 2018 seasons.

Parameters	Year	T1	T2	T3	T4	T5	T6
Shoot length, cm	2017	112.50c	119.11e	110.24b	116.21d	107.36a	112.24c
	2018	113.45c	119.25e	111.23b	116.35d	108.52a	113.55c
Leaf surface area cm^{-2}	2017	99.43c	105.32e	97.65b	102.35d	95.56 a	99.32 c
	2018	99.42c	105.53e	97.66b	102.55d	95.63 a	99.34 c
Bud Brust %	2017	80.72c	83.86e	79.63b	82.91 d	78.66 a	80.66 c
	2018	80.75c	83.88e	79.66b	82.88 d	78.63 a	80.65c

T1 (control), T2 (mulch control), T3 (25% of restriction irrigation water), T4 (25% of restriction irrigation water with mulching), T5 (50% of restriction irrigation water), T6 (50% of restriction irrigation water with mulching), Means followed by the same letter are not statistically different by Duncan at 0.05 levels.

TABLE 4. The effect of rice straw mulching and the restriction of irrigation water on bud fertility and yield in the trail field of king ruby grape during 2017 and 2018 seasons.

Parameters	Year	T1	T2	T3	T4	T5	T6
Bud fertility %	2017	60.55 c	63.35 e	59.66 b	62.66 d	58.66 a	60.54 c
	2018	60. 53 c	63.32 e	58.65 b	62.63 d	58.65a	60.56 c
Yield Kg vine^{-1}	2017	9.61 b	10.62 c	9. 58 b	10.58c	8.56 a	9.51 b
	2018	9.60 b	10.54 c	9.59 b	10.52c	8.54 a	9.55 b

T1 (control), T2 (mulch control), T3 (25% of restriction irrigation water), T4 (25% of restriction irrigation water with mulching), T5 (50% of restriction irrigation water), T6 (50% of restriction irrigation water with mulching), Means followed by the same letter are not statistically different by Duncan at 0.05 levels.

length and width, berry length and width and the juice volume of 100 berries, Table 5 On the other hand, T5 treatment showed the lowest value for all qualities parameters under investigations but T2 and T4 treatments gave similar and highest value. The results come in agreements with (Valdés et al., 2009 and Basile et al., 2011) who found that berries qualities did not improve by excess of soil water content.In the same line Wasko (2010) reported that excessive soil moisture wasdelayed fruit ripening and did not enhance berry size.

Soluble solids were slightly increased in T5 treatment, Table 6 T3 and T6 treatments showed similar content of soluble solids, Table 6. T1, T2 and T4 treatments were revealed lowest value of soluble solids without significant differences between them, Table 6 Lowest acidity was observed in T5 treatment, while the highest value was found in T1, T2 and T4 treatments Table 6 T3 and T6 treatments were showed similar acidity, Table 6 Total sugars outlined opposite results to that found in acidity, where T5 treatment showed slightly the highest total sugar while T1, T2 and T4 treatments showed the lowest value of it. In addition, T3 and T6 treatments were showed similar total sugars, Table 6. The results of anthocyanin were similar to that outlined in total sugars, Table 6 These results come in agreements with (Williams & Matthews, 1990 and Santos et al., 2007) who stated that restricted irrigation improved colors and quality of red grapes. Furthermore, Deluc et al. (2009) stated that water deficit enhanced accumulation of sugar in grapes. Moreover, Dry et al. (2001) linked anthocyanin accumulation to water deficit after veraison.

Total chlorophyll and carbohydrate

Results in Table 7 figured out leaf chlorophyll content and cane carbohydrate content. The

TABLE 5.The effect of rice straw mulching and the restriction of irrigation water on yield, cluster length and width, volume of 100 berries, berry length and width in the trail field of king ruby grape during 2017 and 2018 seasons.

Parameters	Cluster length (cm)		Cluster width (cm)		volume of 100 berries (cm^3)		Berry length (cm)		Berry width (cm)	
Treatments	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
T1	26.63b	26.62b	12.20b	12.21b	381.37b	381.45b	1.86b	1.87b	1.65b	1.66b
T2	28.59c	28.61c	13.56c	13.58c	383.54c	383.52c	1.94c	1.93c	1.72c	1.71c
T3	26.61b	26.63b	12.15b	12.16b	381.38b	381.34b	1.86b	1.85b	1.66b	15.6b
T4	28.63c	28.60c	13.57c	13.56c	383.57c	383.53c	1.92 c	1.93 c	1.71c	1.72c
T5	22.35a	22.71a	11.87a	11.74a	375.65a	375.60a	1.80a	1.81a	1.60a	1.59a
T6	26.58b	26.59b	12.21b	12.19b	381.31b	381.32b	1.86b	1.87b	1.64b	1.64b

T1 (control), T2 (mulch control), T3 (25% of restriction irrigation water), T4 (25% of restriction irrigation water with mulching), T5 (50% of restriction irrigation water), T6 (50% of restriction irrigation water with mulching), Means followed by the same letter are not statistically different by Duncan at 0.05 levels.

TABLE 6. The effect of rice straw mulching and the restriction of irrigation water on soluble solids, titratable acidity, total sugars and total anthocyanin in the trail field of king ruby grape during 2017 and 2018 seasons.

Parameters	Soluble solids(°Birx)		Titratable acidity (g L^{-1})		Total sugars %		Total Anthocyanin (mg100g^{-1})	
Treatments	2017	2018	2017	2018	2017	2018	2017	2018
T1	17.43 a	17.42 a	0.55 c	0.54 c	13.02 a	13.01 a	33.36a	33.37a
T2	17.44 a	17.43 a	0.56 c	0.57 c	12.98 a	12.99 a	33.32a	33.30a
T3	17.51 b	17.52 b	0.47 b	0.48 b	13.16 b	13.14 b	35.56b	35.52b
T4	17.45 a	17.44 a	0.54 c	0.53 c	13.03 a	13.01 a	33.42a	33.41a
T5	17.65 c	17.64 c	0.45 a	0.43 a	13.25 c	13.24 c	37.55c	37.52c
T6	17.51 b	17.53 b	0.47 b	0.49 b	13.17 b	13.15 b	35.58b	35.57b

T1 (control), T2 (mulch control), T3 (25% of restriction irrigation water), T4 (25% of restriction irrigation water with mulching), T5 (50% of restriction irrigation water), T6 (50% of restriction irrigation water with mulching), Means followed by the same letter are not statistically different by Duncanat 0.05 levels.

results of total chlorophyll content appeared that T6 had similar results to T1 with no significant differences Table 7 The lowest value of total chlorophyll content was found in T5 then T3, T4 and T2, respectively, Table 7 The lowest value of total carbohydrate was found in T1, T2 and T4 treatments without significant differences between them,Table 7. T5 treatment showed slightly the highest value of it followed by T3 and T6 with similar results between themTable 7. These results are in accordance with that obtained byGinestaret al. (1998) who stated that excess water content inhibit photosynthesis subsequently reduce total chlorophyll content. On the other hand Deluc et al. (2009) found that total carbohydrates were increased in grapes after exposure to water deficit.

Petiole mineral content

Interestingly vines that exposed to 50% of restriction or saving irrigation water in the presence of rice straw mulching (T6) achieved similar uptake of N, P, K, Ca and Mg to control (T1, full irrigation regime in the absence of mulching), Table 8, T5 treatment showed the lowest value of all nutrients uptake while T2 treatment revealed the highest value followed by T4 and T3, respectively, Table 8. These results are in line with findings from (Agnew et al., 2002 and 2005, Ross 2010 and Nguyen et al., 2013) who found that mulching increasing nitrogen and other nutrients in soils due to the inhibition of leaching and evaporation.

TABLE 7. The effect of rice straw mulching and the restriction of irrigation water leaf chlorophyll content and cane carbohydrate content in the trail field of king ruby grape during 2017 and 2018 seasons.

Parameters		T1	T2	T3	T4	T5	T6
Total chlorophyll mg g FW^{-1}	2017	9.89 c	11.54 e	9.22 b	10.58 d	8.85 a	9.88 c
	2018	9.87 c	11.24 e	9.24 b	10.85d	8.65 a	9.86 c
Total carbohydrate %	2017	23.04 a	22.97 a	23.12 b	23.02 a	23.26 c	23.14 b
	2018	23.03 a	22.98 a	23.13 b	23.01 a	23.27 c	23.13 b

T1 (control), T2 (mulch control), T3 (25% of restriction irrigation water), T4 (25% of restriction irrigation water with mulching), T5 (50% of restriction irrigation water), T6 (50% of restriction irrigation water with mulching), Means followed by the same letter are not statistically different by Duncan at 0.05 levels.

TABLE8.The effect of rice straw mulching and the restriction of irrigation water on the uptake of nitrogen (N), phosphorus (P), potassium (K), calcium (Ca) and magnesium (Mg) in the trail field of king ruby grape during 2017 and 2018 seasons.

Parameters	N %		P %		K %		Ca %		Mg %	
Treatments	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**
T1	2.61**c**	2.60**c**	0.39**c**	0.38**c**	2.39**c**	2.39**c**	1.31**c**	1.33**c**	0.51**c**	0.52**c**
T2	2.88**e**	2.89**e**	0.49**e**	0.48**e**	2.51**e**	2.52**e**	1.57**e**	1.58**e**	0.59**e**	0.58**e**
T3	2.43**b**	2.41**b**	0.30**b**	0.32**b**	2.31**b**	2.32**b**	1.23**b**	1.24**b**	0.37**b**	0.38**b**
T4	2.75**d**	2.77**d**	0.42**d**	0.41**d**	2.44**d**	2.45**d**	1.43**d**	1.44**d**	0.45**d**	0.44**d**
T5	2.33**a**	2.35**a**	0.29**a**	0.28**a**	2.27**a**	2.28**a**	1.17**a**	1.18**a**	0.31**a**	0.30**a**
T6	2.59**c**	2.58**c**	0.38**c**	0.39**c**	2.38**c**	2.37**c**	1.30**c**	1.31**c**	0.51**c**	0.50**c**

T1 (control), T2 (mulch control), T3 (25% of restriction irrigation water), T4 (25% of restriction irrigation water with mulching), T5 (50% of restriction irrigation water), T6 (50% of restriction irrigation water with mulching), Means followed by the same letter are not statistically different by Duncan at 0.05 levels.

Conclusion

Based on these results, it can be conclude that application of rice straw mulching should be targeted to save 50 % of irrigationwater (T6 treatment) after veraison in vineyards cultivated in Delta Nile of Egypt as alternative agriculture practices for keeping balance of growth parameter, yield level and improving quality of King ruby grapes. To reach this goal authors highly recommend growers to fellow irrigation regime with 20 days irrigation intervals from May till end of July using rice straw covering soil surfaces between rows with renewing it every year at the same period.

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Conflicts of interest

The authors declare that there are no conflicts of interest related to the publication of this work.

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تأثيرالتغطية بقش الأرز على كفاءة إستخدام المياه ونمو ومحصول وجودة عنب الكنج روبى تحت ظروف الرى السطحى

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مايو حتى نهاية شهر يوليو (وقت الحصاد) وذلك بتصميم تجربة قطاعات كاملة العشوائية بست معاملات تم إضافة قش الأرز بمعدل ٥كجم للمتر المربع لتغطية التربة بين صفوف الأشجار لثلاث قطاعات تم فيها تقليل كمية مياه الرى للربع والنصف وذلك بتباعد فترات الرى ل١٥ و ٢٠ يوم لمقارنتها بفترات الرى المتبعة من قبل المزارع (١٠ أيام- الكنترول). أظهرت النتائج أن تغطية التربة بقش الأرز حافظ على مستوى الرطوبة بالتربة فى المعاملة التى قللت فيها كمية مياه الرى للنصف لمستوى مشابه للكنترول ، وهذا إنعكس على تحسين صفات التربة (كمية الماء المتاح ،معدل الرشح ،الكثافة الظاهرية) وصفات النمو (نمو الأفرخ ، مساحة الأوراق، مستوى الكلوروفيل ، خصوبة البراعم ، كمية المحصول) وذلك لمستوى مشابه وقريب من الكنترول أما صفات الجودة (طول وعرض الحبات والعناقيد ، مستوى السكر والمواد الذئبة الكلية ، صبغة الأنثوثيانين) فقد أظهرت تفوق على تلك الصفات المرصودة فى معاملة الكنترول. مما سبق يمكن التوصية بتباعد فترات الرى كل ٢٠ يوم مع تغطية التربة بقش الأرز وذلك لتوفير كمية المياه المستخدمة فى الرى وتحسين صفات الجوده مع المحافظة على كمية المحصول فى المستوى الأمثل.

أجريت الدراسة خلال عامى ٢٠١٧ و٢٠١٨ بمزرعة خاصة بقرية أبو الغر – مركز كفر الزيات – محافظة الغربية- مصر وذلك على كرمات عنب صنف كنج روبى عمره أربع سنوات منزرعة على مسافات ٢X٣ ومرباه على تكاعيب البارون الأسبانية وذلك بأربع أذرع موزعة فى أربع إتجاهات وكل ذراع عليه ثلاث قصبات وإستهدف حمل ٢٥ عنقود لكل كرمه بعد وصول حجم العناقيد لحوالى ١٠ سم فى الطول أثناء موسم النمو. بدأت التجربة فى مرحلة ما قبل إكتمال النمو بداية من شهر