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Orchard Management for Decreasing Date Palm Bunch Fading Disorder

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Abstract
The date palm bunch fading disorder/disease is one of the greatest challenges faced by date palm growers. In the present study, the effect of appropriate orchard management on some qualitative and quantitative features of date palm bunch was studied. For this purpose, two orchards of cv 'Kabkab' with a history of previous incidence were selected in two districts of Bushehr province; Tangestan and Dashtestan. The orchards were divided into two parts; one as control and another as treated plants. On the treated part, some management practices such as plowing, leaf pruning, proper nutrition, regular irrigation, pollination, regulation of leaf-bunch ratio, thinning in pollination stage, control of weeds, pests and diseases were conducted scientifically while the control part was maintained with conventional local practices. During the treatment phase, all bunches in the Khalal stage were covered with a white cloth bag. The results from both treatment plots showed that proper orchard management can improve fruit yield (Dashtestan 52.2 kg tree^{-1}, Tangestan 88.1 kg tree^{-1}) and reduce the severity of symptoms and therefore reduce date palm bunch fading disorder.

Keywords: fruit quality, khalal stage, rutab stage, tropical plants, yield.

Introduction

Date bunch fading disorder (DBFD) has been one of the greatest concerns of Iranian date producers in recent years. Orchards with dominant cvs in the provincial areas of Kerman (cv 'Muzafati'), Hormozgan (cv 'Mordasang'), Khuzestan (cv 'Estamaran') and Bushehr (cv 'Kabkab') have been severely damaged (Marashi and Pezhman 2003; Damankeshan and Panahi 2013). Since DBFD usually occurs during fruit development which is economically significant, i.e. Khalal to Rutab stage, yield loss is devastatingly high. This disorder occurs only in the generative maturing tissues, starting with light yellow lesions on peduncles (the main stalk of the bunch) and gradually developing to longitudinal pale brown strips on the whole peduncle. Date fruits then begin to wilt from the bottom of the strand upward. Eventually, pedicels, peduncles and the whole bunch will be affected. Affected bunches have been reported to shed their fruits (Karampour *et al*., 1999; Mirzaei *et al*., 2001; Karampour *et al*., 2002; Karimipour Fard and Latifian, 2002; Karampour *et al*., 2007). DBFD shows no visual symptoms on root, trunk and leaves of infected palm trees. Fungi spores, bacteria, overloaded fruit, no thinning and climate changes are some of the factors that are believed to

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have effects on on the appearance of this disorder (Mirzaei *et al*., 2001; Karampour and Pezhman, 2004; Mansoori, 2012), however, none of them has been proven to be the main cause (Pezhman *et al*., 2005). According to previous studies on PBFD and the fact that it spreads fast, it seems that it's occurrence and severity are influenced by adverse climatic and environmental factors such as hot and dry winds and very low relative humidity (severe drought) (Karampour, 1999, 2002; Rousta, 2003; Karampour and Pezhman, 2004; Poozesh Shirazi *et al*., 2004; Rahkhodaei, 2004; Sarhadi and Ghalebi, 2004; Shirazi *et al*., 2008). Intercropping with alfalfa and sorghum in infected date plantation has been reported to be effective in reducing the damage caused by this disorder (Darini and Izadi, 2001). Covering of bunches with aluminum foil and mat-like basket has been reported to reduce the damage caused by the disorder (Pezhman *et al*., 2005). In an attempt to find the cause of PBFD, several fungi species were isolated from infected bunches among which is *Thielaviopsis paradoxa*, considered to act as a secondary agent for this disorder when trees are under environmental stress (Karampour, 2002). The level of damage could be related to the quality of horticultural management in infected palm plantation. It is believed that desirable cultural management would lead to insignificant level of damage in palm cultivation (Mirzaei *et al*., 2001). The objective of this study is to evaluate the effect of orchard management on DBFD in the Southern province of Busheher, Iran.

Materials and Methods

This study was conducted during 2009 to 2011 in commercial orchards in Dashtestan and Tangestan districts. The orchards were divided into two plots, one as control and the other as treated plot. In the treatment part, plowing, leaf pruning, proper nutrition (Table 1), regular irrigation, proper pollination, regulation of leaf-bunch ratio, thinning in pollination stage, control of weeds, pests and diseases were practiced scientifically while in control plot conventional practices in the region were practiced. Bunches in the Khalal stage were covered with white cloth bags in treated plot. Ten trees were selected and marked randomly in each part of the orchard. Each fruit was then weighed and average fruit weight per plot was estimated. The width and length of each fruit were measured with a digital caliper. The ratio was estimated by dividing fruit pulp by seed while fruit juice was obtained by blending the above halved fruit pulps without seeds. Total soluble solid (TSS) was measured with a hand held refractometer (Nippon Optical Works, Co., Ltd. Tokyo, Japan) while fruit volume was estimated by the water displacement method (Akar and Aydin, 2005). Furthermore, yield, pH, fruit humidity and fading percentages were measured. Data were analyzed with SPSS Version 15 statistical software and means were compared by t-test.

Table 1. Fertilizers used in treatment part of the experiment

Nutrient	Application amount (g palm^{-1})	Time of application
Super phosphate triple	600-700	Feb.
Potassium sulphate	1000-1200	Feb.
Urea	600-700	Feb. and May
Chelate-Fe	100	Feb. and May
Zinc sulphate	150-200	Feb.

Results

Orchard management significantly ($P \leq 0.01$) decreased DBFD rate compared to control in both sites/plots (Fig. 1). The highest (27.15%) and the lowest (6.5%) DBFD percentage occurred in the control and treated orchard respecetively, in the Dashtestan region. The data shows the same results in the Tangestan region.

The results in Table 2 show that the application of orchard management significantly improved seed weight, length and diameter in Dashtestan region while there were no significant differences in Tangestan region. The lowest fruit weight was observed in the control treatment (7.97 and 9.89 g) while orchard management could significantly increase fruit weight in both regions (9.67 and 11.94 g, respectively).

Table 2 shows that the highest fruit volume was recorded for orchard management in both regions (8.53 and 10.10 cm^3) while the lowest observed in the control orchard (7.15 and 7.81 cm^3). The highest fruit length and diameter (3.92 and 2.23 cm) were obtained when orchard management was applied in the Tangestan region while no significant differences were found in fruit length and diameter between control and managed orchard in the Dashtestan region (Table 2).

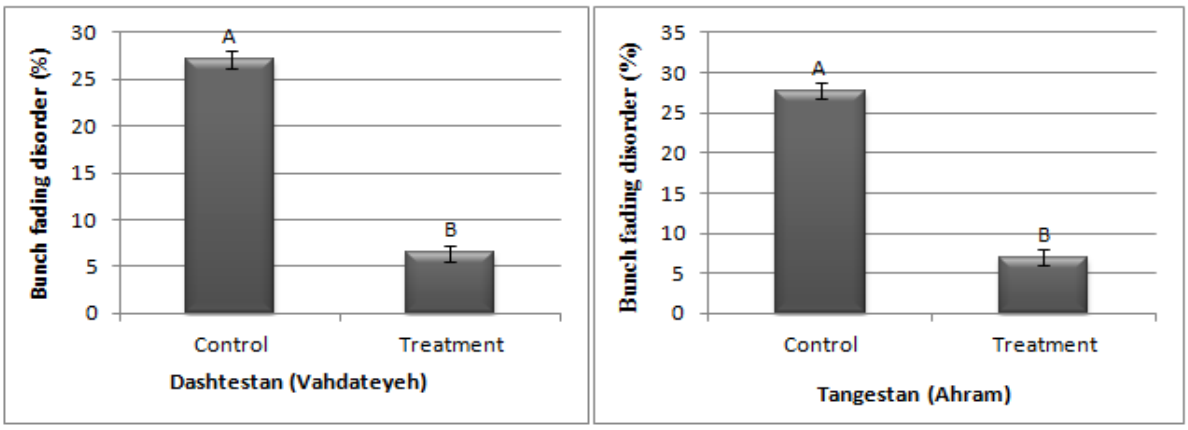

Fig. 1. Effects of orchard management on bunch fading disorder in Dashtestan and Tangestan

Table 2. Effects of orchard management on fruit weight, fruit length, fruit diameter, fruit volume seed weight, seed length and seed diameter in both sites of the experiment

Site of the experiment	Treatment	Fruit weight (g)	Fruit length(cm)	Fruit diameter(cm)	Fruit volume (cm^3)	Seed weight (g)	Seed length (cm)	Seed diameter (cm)
Dashtestan	orchard management	9.67 a*	3.57a	2.2a	8.53 a	0.77a	2.13a	0.71a
	Control	7.97b	3.37a	2.15a	7.15 b	0.65b	1.94b	0.68b
Tangestan	orchard management	11.94a	3.92a	2.23a	10.10 a	0.95a	2.38a	0.73a
	Control	9.89b	3.44b	2.13b	7.81 b	0.91a	2.34a	0.72a
Mean	orchard management	10.8a	3.75a	2.22a	9.31 a	0.86a	2.25a	0.72a
	Control	8.93b	3.39b	2.14b	7.48 b	0.78a	2.14b	0.7a

* In each column for each site, means with the same letters are not significantly different according to t test at 1%.

No significant differences were found in seed weight; length and diameter between orchard management and control in Tangestan region but orchard management was effective in improving this trait in the Dashtestan region. Differences in seed weight, length and diameter between treated and control plots were significant ($P \leq 0.01$) (Table 2). The highest yield was obtained in Dashtestan (52.2 kg tree^{-1}) and Tangestan (88.1 kg tree^{-1}) regions when orchards were managed scientifically compared to conventionally maintained orchards (36.1 and 54.58 kg tree^{-1}, respectively) (Fig. 2).

The highest TSS, pulp/seed ratio and moisture content in Dashtestan region occurred when orchard management was applied. The application of orchard management in Tangestan region increased pulp/seed ratio and moisture content more than in the control (Table 3).

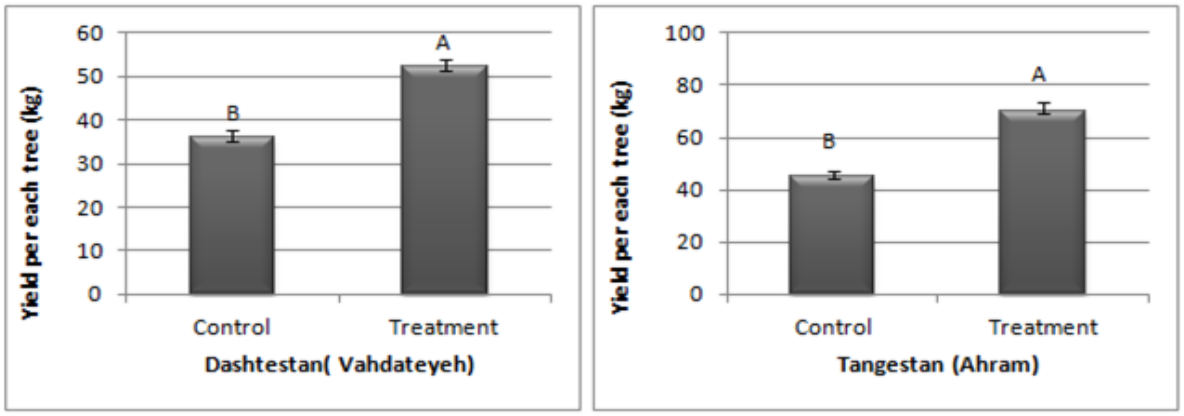

Fig. 2. Effects of orchard management on yield in Dashtestan and Tangestan

Table 3. Effects of orchard management on pulp/seed ratio, TSS, pH, moisture content in both sites of the experiments

Site of the experiment	Treatment	Pulp/seed ratio	TSS	pH	moisture content
Dashtestan	Orchard management	8.9 a *	85.05a	5.82a	19.7a
	Control	7.32b	82.4b	5.42a	17.05b
Tangestan	Orchard management	10.99a	84.1a	5.305a	20.0a
	Control	8.98b	83.65b	5.515a	15.9b
Mean	Orchard management	9.95a	84.59a	5.565a	19.85a
	Control	8.15b	83.03b	5.468a	16.44b

* In each column for each site, means with the same letters are not significantly different according to t test 1% level.

Discussion

When establishing a new date plantation, certain actions need to be implemented to ensure the long term success. Some of these actions include land preparation, availability and quality of irrigation, leaf pruning, pollination, regulation of leaf-bunch ratio, thinning at pollination stage,

control of weeds, pests and diseases (Mirzaei *et al*., 2001; Dialami and Pezhman, 2005; Ghaffarinejad *et al*., 2005). In our experiment, orchard management decreased DBFD in both regions and these results are in agreement with those of other researchers (Mirzaei *et al*., 2001; Saei, 2001; Poozesh Shirazi *et al*., 2004; Rahkhodaei, 2004; Izadi and Poozesh, 2010). Most soils are generally poor in organic matter and improving this condition plays an important role in soil fertility. Nutrient elements are necessary for plant growth and fruit production (Rousta, 2003). The results showed that orchard management was more effective in decreasing the damage caused by DBFD. A number of studies have considered the relationship between fertilizer applications and DBFD (Ghaffarinejad *et al*., 2005; Dialami and Pezhman, 2005). Trunk injection of calcium sulfate and chloride did not significantly affect the occurrence of DBFD, while injection of calcium nitrate significantly decreased DBFD (Ghaffarinejad *et al*., 2005). Foliar application of potassium sulfate, potassium nitrate and manganese sulfate markedly improved the physical characteristics of fruits including fresh weight, length, diameter and volume (Dialami and Pezhman, 2005). Rousta (2004) reported that foliar application of potassium sulfate and calcium chloride with or without soil application of micronutrients decreased DBFD. Commercial date production necessitates artificial pollination which ensures good fertilization and overcoming dichogamy. 60-80% pollination of the female flowers is considered to be satisfactory and will usually lead to a good fruit set. The results of similar studies has shown the usefulness of pollination (Mara'shi and Pezhman, 2003; Damankeshan and Panahi, 2013). Bunch thinning is highly related to climate and reduces damage due to humidity by ensuring better air circulation around the fruits which then reduces the risk of fruit fermentation, rot and souring (Izadi *et al*., 2010). Thinning of bunches is one of the orchard management practices essential in the production of commercial date for export as it leads to the production of fruits with high quality and more marketable features by increasing fruit size, skin color and shape (Pezham *et al*., 2005). Tavakoli (2002) Working with cv Shahani concluded that fruit thinning would increase the size and quality of fruit. Izadi (2010) reported significant decreases in DBFD with fruit thinning in 'Kabkab' cultivar. Reports from Jiroft area showed that concurrent thinning and pollination as management practices decreased losses brought about by this disorder (Saei, 2001; Damankeshan and Panahi, 2013). Covering fruit bunches, commonly used in the new areas of date cultivation , offers several advantages such as protecting the fruits from high humidity and rain, bird and insect attacks (Mara'shi and Pezhman, 2003). Pezhman *et al*. (2005) reported that using mat-like basket bunch cover reduced the daily mean temperature to about 4.3°C compared to bunches without cover. Studies have shown that harsh climatic factors accelerate the disorder while proper orchard management can significantly decrease the disorder. It was observed that applying integrated practices was more effective than using each practice separately.

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