EFFECTS OF ACTIVATED BRACKISH WATER IRRIGATION ON THE GROWTH AND WATER USE EFFICIENCY OF MATURE FRAGRANT PEAR (*PYRUS PYRIFOLIA* L.)

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(Received 9th Aug 2021; accepted 23rd Nov 2021)

Abstract. Understanding the effect and mechanism of activated brackish water irrigation on fruit tree growth is of great significance to improve the utilization efficiency of brackish water in Xinjiang, China. In this study, Korla fragrant pear (*Pyrus pyrifolia* L.) was taken as the research object, and a two-year field irrigation experiment was carried out using brackish water (B), magnetized brackish water (MB) and ionized brackish water (IB) to study the effects of activated brackish water on the growth of new shoots, fruit shape, yield and quality, and water use efficiency of mature fragrant pear. The results showed that the rhizosphere soil water content increased somewhat under the activated brackish water irrigation. Compared to treatment B, the average soil water content under MB and IB irrigation increased by 13.07%-14.90% and 28.15%-28.55%, respectively. In addition, the activated brackish water irrigation could effectively promote the growth and fruit development of fragrant pear trees. Compared with treatment B, the maximum new shoot lengths increased by 17.87%-28.33 and 48.79%-51.12%, the fruit shape index increased by 9.62%-11.68% and 9.58%-10.66%, respectively, the volume of fragrant pear increased by 8.96%-11.96% and 11.89%-15.54%, respectively, the yield of fragrant pear increased by 11.20%-22.22% and 12.47%-25.08%, respectively, and water use efficiency increased by 12.97%-25.24% and 14.15%-26.21%, respectively. Furthermore, the single fruit weight and soluble solid content of fragrant pear significantly increased ($P < 0.05$), while the hardness and total acid content significantly decreased ($P < 0.05$). In conclusion, activated brackish water irrigation can effectively improve the yield and water use efficiency of fragrant pear, and ameliorate the shape and quality of fragrant pear fruit, alleviate the negative effects of brackish water.

Keywords: *magnetized brackish water, ionized brackish water, fragrant pear, yield and quality*

Introduction

Fragrant pear (*Pyrus pyrifolia* L.) is well-known inside and outside of China for its thin skin, thin meat, crisp and sweet juice and strong flavor (Niu et al., 2019). It has become one of the important high-earning export agricultural products in southern Xinjiang, China (Chen et al., 2020a). However, due to the large water consumption of fragrant pear and the extreme shortage of fresh water resources in Xinjiang, the sustainable development of forest and fruit industry in this area is seriously restricted (Li et al., 2020b). The development and utilization of brackish water resources has become an adaptation strategy for drought resistance and yield increase in fruit tree cultivation in freshwater deficient areas (Han et al., 2019). However, there are salt ions in the brackish water. During irrigation, the water enters the soil, causing the accumulation of salt, resulting in the deterioration of the environment in the rhizosphere of fruit trees (Yuan et al., 2019), hindering the absorption of water and nutrients by the roots of fruit trees, thus

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2001_671683

reducing their productivity (Chen et al., 2018). Therefore, the continuous search for new technologies to improve the quality of brackish water has become a hot topic.

Activated water treatment technology mainly includes magnetized and ionized water treatment methods (Mu et al., 2019). After activation treatment, the physical and chemical properties of water change, the surface tension decreases, the viscosity and half peak width of 17O-NMR increase, and the associated water molecules decompose (Al-Bayar et al., 2020). When the activated brackish water enters the soil through irrigation, the proportion of soil exchangeable sodium ions decreases, and the substitution amount of calcium ions and magnesium ions increases, which changes the exchange characteristics and ion composition of soil base ions (Hamza, 2019), so as to ameliorate soil physical and chemical properties, improve the availability of soil nutrients, provide more ionic nutrients for crop growth, and promote the growth and development of crops (Abdel-Kader et al., 2020). Wang et al. (2021) showed that activated water irrigation could improve wheat root activity, improve root configuration, enhance leaf chlorophyll content and improve wheat yield. Turker et al. (2007) applied a stable magnetic field perpendicular to the gravity field of sunflower and found that both chlorophyll a and chlorophyll b of sunflower increased. Maheshwari and Grewal (2009) found that magnetized water improved the growth and physiological indexes of crops, such as the SPDA value of crop leaves, leaf area index and relative water content of plant leaves. Zhou et al. (2021) pointed out that the cotton yield under irrigation with 300 mT magnetized water increased by 28.8%-31.69%, and the water use efficiency increased by 27.4%-42.8%. Surendran et al. (2016) believed that when the water flowed through the magnetic field, the positive and negative ions in the water were forced to separate. After entering the soil, the nutrient ions were easier to move, and the water molecules were easier to adhere to the soil pores and. It played a role in maintaining the water in the root zone of crops and promoting the growth of peas. Zhao et al. (2021) pointed that the yield of wheat irrigated with magnetized water and ionized water increased by 10.1% and 13.9%, respectively, and the water use efficiency increased by 8.8% and 7.9%, respectively.

At present, there has been extensive research on the activated brackish water irrigation of grain and economic crops, but there is little research on the activated water irrigation of fruit trees. Korla fragrant pear, as a unique variety in China, the impact of activated brackish water irrigation on the growth of fragrant pear fruit trees has not been reported publicly. Therefore, taking the mature fragrant pear fruit trees as the research object, through a two-years of field experiment, this paper analyzed the effects of activated brackish water on the growth, fruit shape, quality, yield and water use efficiency of fragrant pear trees, so as to provide a theoretical basis for the application of activated brackish water in fruit tree irrigation.

Materials and methods

Experimental site description

From 2018 to 2019, the experimental study was carried out in a pear garden (41°45'N, 86°10'E, 901 m a.s.l.) of water conservancy Research Institute of Tarim River Basin Authority, Korla City, Xinjiang, China. Located in the hinterland of the Eurasian continent, the experimental site is a typical temperate continental arid climate area, with an average annual temperature of 11.6 ℃. The average annual precipitation is 58.6 mm, the average annual evaporation is 2257.2 mm, the frost free period is 226 d, and the

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
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average annual sunshine hours is 2769.8 h (Wang et al., 2019b). The meteorological elements during the growth period of fragrant pear in 2018 and 2019 were shown in *Fig. 1*. The cumulative reference crop evapotranspiration (ET_0) during the growth period of fragrant pear in 2018 is 1050 mm, and the cumulative rainfall (*R*) was 60 mm. In 2019, ET_0 during the growth period of fragrant pear was 1025.8 mm, and the cumulative rainfall (*R*) was 42.9 mm. Before the test, the basic physical and chemical properties of the soil in the 0-100 cm soil layer of the test site were measured. According to the soil texture classification of the U.S. Department of agriculture, the soil in the test area is sandy loam (50.2% sand, 46.0% silt and 3.8% clay), with an average unit weight of 1.56 $g \cdot cm^{-3}$, a saturated volume water content of 0.43 $cm^3 \cdot cm^{-3}$, a field water capacity of 0.25 $cm^3 \cdot cm^{-3}$, a wilting coefficient of 0.05 $cm^3 \cdot cm^{-3}$, a pH value of 7.8, a total nitrogen content of 0.84 $g \cdot kg^{-1}$ and an organic matter content of 13.24 $g \cdot kg^{-1}$ (Chen et al., 2020b). The content of alkali hydrolyzable nitrogen is 57.46 $mg \cdot kg^{-1}$, the content of available phosphorus is 9.85 mg kg^{-1}, and the content of available potassium is 136.52 $mg \cdot kg^{-1}$ (Li et al., 2019). From 2018 to 2019, the average buried depth of underground level is 6.5 m. The brackish water comes from underground well water, and its salinity is 1.83-2.74 $g \cdot L^{-1}$. *Fig. 1* showed the main meteorological factors during the growth period of fragrant pear.

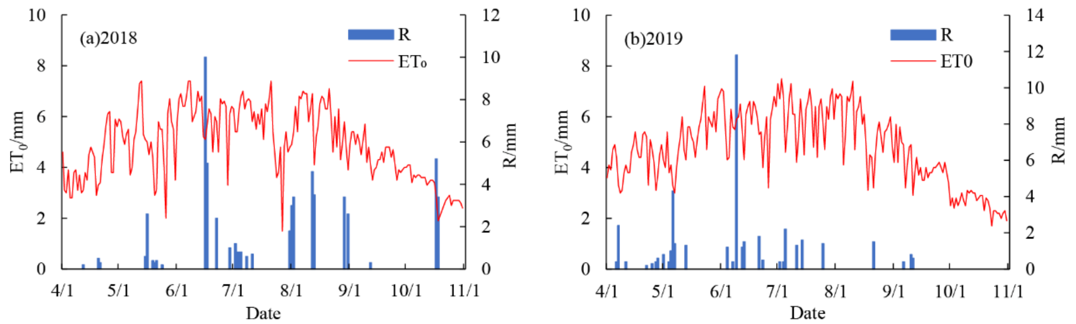

***Figure 1.** Main meteorological elements in growth period of fragrant pear. ET0 and R represent the reference crop evapotranspiration and rainfall, respectively*

Magnetizer and magnetized water device

The test started in early April and ended in mid-September every year. The tested materials were 15-year-old fragrant pear trees with a row spacing of 4 m × 6 m (417 trees $\cdot hm^{-2}$). 3 rows of fragrant pear trees with similar tree shape were selected, and divided into 9 communities. Each community was 12 m long and 6 m wide, including 5 fragrant pear trees. Taking different irrigation water treatments as influencing factors, three groups of treatments were set up, namely brackish water (B), magnetized brackish water (MB) and ionized brackish water (IB). Each treatment controlled the irrigation of 5 fragrant pear trees, repeated for 3 times and arranged randomly. Both the magnetized water processor and the ionized water processor were installed on the irrigation water diversion pipeline. The magnetized water processor adopted the pipeline magnetizer (XS300) with a magnetization of 300 mT produced by Urumqi Water-saving Equipment Research and Development Center, Xinjiang, China. The ionized water processor (W600DELF) is produced by Korea Yameihua (Beijing) environmental technology Development Co., Ltd, China. According to the research of Wang et al. (2016), the technical parameters of the equipment were adjusted and controlled. The irrigation method was small tube outflow. 4mm capillary was used to arrange 4 small tubes around

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the fragrant pear tree, and the small tube flow was 8 $L \cdot h^{-1}$. The irrigation quota was 5625 $m^3 \cdot hm^{-2}$. Irrigation had been started since April 22, and the irrigation cycle was 10 days. A total of 15 times of irrigation had been carried out during the growth period, and the irrigation quota was 375 $m^3 \cdot hm^{-2}$. The fertilization method was ditch application. During the growth period, 652 $kg \cdot hm^{-2}$ urea (containing 46% N), 543 $kg \cdot hm^{-2}$ heavy superphosphate (containing 46% P_2O_5) and 118 $kg \cdot hm^{-2}$ potassium sulfate (containing 51% K_2O) were applied. Other field management of each treatment group was consistent during the experiment. The old bark of fragrant pear fruit trees should be pruned and scraped before the end of February every year, meanwhile, the orchard should be clean. The chemicals should be sprayed before budding to reduce the base number of diseases and pests. When applying fertilizer, the root with a diameter of 0.5 cm should be careful not to hurt.

Determination index and method

Soil water content

PR2 soil water monitoring system (Davis instruments, California, USA) was adopted to determine the soil water content. Three trees with similar growth and healthy were randomly selected for each treatment. A PR2 pipe with a depth of 100 cm was buried at 50 cm and 100 cm in four directions along the East, West, North, South of each tree. There were 8 water monitoring points for each tree and 24 water monitoring points for each treatment. The soil water content was measured every 20 days at the depths of 10, 20, 30, 40, 60 and 100 cm, respectively. The soil moisture content determined by PR2 was calibrated according to the regression equation given by Liang et al. (2019).

Shoot length

According to the actual growth status of fragrant pear trees, 3 fragrant pear trees with uniform growth were selected for each treatment. During the germination period of fragrant pear trees, 4 new shoots with strong growth were randomly selected from the East, West, North and south directions around the crown as markers, and the length and diameter of new shoots were measured with steel tape and vernier caliper. They were measured every 7 days for 6 consecutive cycles.

Fruit shape, yield and quality

The yield of fragrant pear was measured in the first ten days of October every year. Three fragrant pear trees were randomly selected for each treatment, and the total number of fruits produced by each fragrant pear tree was accurately counted. 10 fragrant pear fruits are randomly picked on each fragrant pear tree. The longitudinal diameter (D_Z, mm) and transverse diameter (D_H, mm) were measured with vernier caliper, and the fruit shape index (Wang et al., 2020) ($SI = D_Z/D_H$) and volume (Wu et al., 2012) ($V = 0.002\, D_Z^{\,1.864}\, D_H^{\,0.803}$, cm^3) were calculated. The single fruit weight of fragrant pear was measured with an electronic scale with an accuracy of 0.01 g. The product of the single fruit weight and the total number of fruits was taken as the average yield per plant, and the total yield was obtained by area conversion based on the yield per plant. Two samples were selected from four directions of each fragrant pear tree, East, West, North and South, a total of 8 samples were selected to determine the fruit quality. The fruit hardness was determined by GY-2 fruit hardness tester (Vetus Instruments, USA), the soluble solid content was determined by WYT-4 handheld sugar meter (Guangzhou Mingrui Co., Ltd, China), the total acid

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content was determined by NaOH titration, and the vitamin C content was determined by dichloroindophenol titration.

Meteorological data

The Vantage Pro2-6152c meteorological station produced by Davis company of the United States was used to monitor the meteorological data such as maximum temperature, minimum temperature, sunshine time, 2 m wind speed, air humidity and rainfall during the growth period of fragrant pear.

Calculation of water consumption and water use efficiency

The water consumption in the growth period of fragrant pear fruit trees is calculated by water balance:

$$ET = SWC + I + R + U - D - R_0 \quad \text{(Eq.1)}$$

where, *ET* represents the water consumption of fragrant pear tree (mm). *SWC* represents the water storage in the main root zone of fragrant pear fruit tree (mm). *I* represents the amount of irrigation, mm. *R* represents the rainfall (mm). *U* represents the recharge of groundwater (mm). *D* represents the deep leakage (mm). R_0 is the surface runoff (mm). Since the buried depth of groundwater is greater than 6m, *U* could be ignored. In this test, small pipe outflow is adopted, the irrigation quota is small, there will be no leakage, so *D* can be ignored. The irrigation quota is small, there will be no surface runoff, so R_0 can be ignored;

Since *U*, *D* and R_0 are negligible, Eq. (1) can be simplified as:

$$ET = SWC + I + R \quad \text{(Eq.2)}$$

The water storage in the main root zone of fragrant pear can be calculated according to the measured soil water content data:

$$SWC = 1000H(\theta_{t_2} - \theta_{t_1}) \quad \text{(Eq.3)}$$

where, *H* represents the depth of main root zone of fragrant pear (m). θ_{t1}, θ_{t2} represent the average water content of soil at the depth of 0-100cm in the main root zone at t_1 and t_2.

The water use efficiency (*WUE*) of fragrant pear fruit trees can be expressed as:

$$WUE = 100Y / ET \quad \text{(Eq.4)}$$

where, *WUE* represents the water use efficiency of fragrant pear trees ($kg \cdot m^{-3}$). *Y* represents the yield of fragrant pear ($t \cdot hm^{-2}$).

Data processing and analysis

The data were recorded in Excel 2019 and analyzed using SPSS 22.0 software (IBM Corp. USA). Duncan method was used for significance test and analysis of variance ($P < 0.05$).

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Results and Discussion

Effect of activated brackish water irrigation on soil water content

The water content of 0-100 cm soil under the irrigation of activated brackish water during the growth period is shown in *Fig. 2*. The soil water content fluctuated in the whole growth period, which was mainly related to irrigation, rainfall, evaporation and other factors (Tan et al., 2017). The soil water content under activated brackish water irrigation was significantly higher than that under brackish water control, while the soil water content under IB irrigation was slightly higher than MB. In 2018, the average soil water content under MB irrigation increased by 14.90% compared with control B, and the average soil water content under IB irrigation increased by 28.55% compared with control B. In 2019, the average soil water content under MB irrigation increased by 13.07% compared with control B, and the average soil water content under IB irrigation increased by 28.15% compared with control B. The experimental results of the two years were slightly different, but they were consistent with the results of Wang et al. (2021). The results indicate that activated brackish water irrigation con effectively improve the soil water content during the growth period of fragrant pear. This is mainly because the associated water molecular cluster and contact angle become smaller after the activation treatment of brackish water (Chibowski and Szcześ, 2018), and the water is easier to enter the small soil pores, which can store a large amount of water in the soil effective pores and reduce the evaporation loss (Shan et al., 2021). As a result, the soil water content of 0-100 cm under activated brackish water irrigation is higher as a whole.

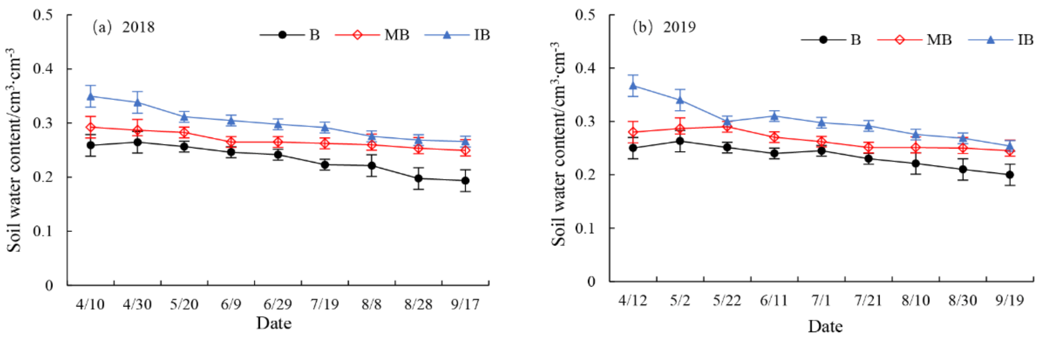

***Figure 2.** Soil water content of fragrant pear during growth period under activated brackish water irrigation. B, MB and IB represent brackish water, magnetized brackish water and ionized brackish water, respectively. The error bars represent standard deviations*

Effect of activated brackish water irrigation on new shoot length of fragrant pear trees

New shoots and branches are the basic unit of flowering and fruiting of fragrant pear tree. The length of new shoots is directly related to the transmission efficiency of nutrients and fruit development of fragrant pear tree (Wu et al., 2012). *Fig. 3* showed the change process of new shoot length of fragrant pear tree under activated brackish water irrigation at leaf spreading stage. During the leaf development period of fragrant pear, the length of new shoots and branches of each treatment increased with the advance of growth time. In 2018, the maximum shoot length of fragrant pear fruit trees irrigated with B, MB and IB was 43.55 cm, 51.33 cm and 64.80 cm, which increased by 17.87% and 48.79% compared with control B. In 2019, the maximum shoot length of fragrant pear fruit trees irrigated

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with B, MB and IB was 41.55 cm, 53.32 cm and 62.79 cm, which increased by 28.33% and 51.12% compared with control B. Wang et al. (2019a) showed that the shoot growth of grapes irrigated with magnetized brackish water increased by 25.56%, and Wang et al. (2021) showed that the dry matter mass of wheat irrigated with ionized water increased by 29.7%, which were consistent with this study. Therefore, the activated brackish water irrigation is beneficial to promote the growth of new shoots of fragrant pear fruit trees and effectively increase the biomass of fragrant pear fruit trees. On the one hand, the activated brackish water irrigation improves the soil water storage in the main root layer of fragrant pear trees and provides sufficient water for the growth of new shoots of fragrant pear trees (Zhao et al., 2021), on the other hand, the water quality performance of activated brackish water is improved (the reducing of surface tension (Liu and Cao, 2021) and the increase of dissolved oxygen and solubility (Wang et al., 2018)), salt activity is reduced (Bu et al., 2010), and the carrying capacity of nutrient elements is improved (Liu et al., 2020), which provides sufficient nutrients for the growth of new shoots of fragrant pear fruit trees, resulting in faster growth of new shoots of fragrant pear trees.

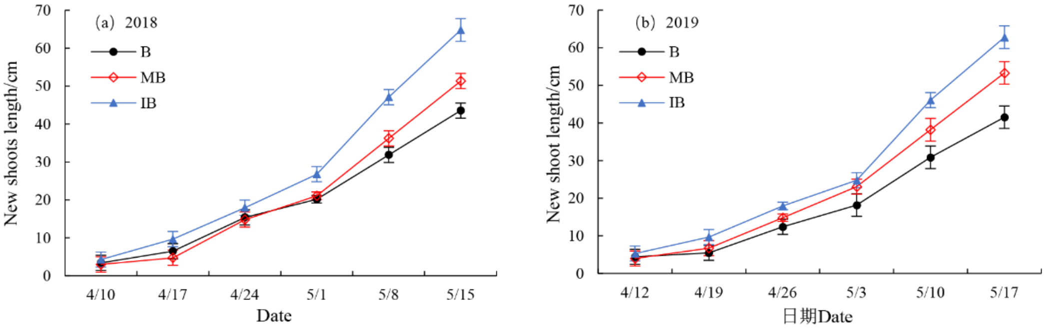

Figure 3. *New shoot lengths of fragrant pear tree under activated brackish water irrigation. B, MB and IB represent brackish water, magnetized brackish water and ionized brackish water, respectively. The error bars represent standard deviations*

Effect of activated brackish water irrigation on fruit shape of fragrant pear

The fruit shape of fragrant pear is one of the important indicators that determine whether its commodity value is competitive in the high-end international pear market (Chen et al., 2020). As can be seen from *Table 1*, activated brackish water irrigation had significant effect on fruit shape of fragrant pear ($P < 0.05$). Compared with control B treatment, the longitudinal diameter of fragrant pear irrigated with MB and IB increased by 6.76%, 7.22% (2018) and 7.25%, 8.83% (2019), the transverse diameter decreased by 4.40%, 2.16% (2018) and 2.17%, 1.65% (2019), the fruit shape index increased by 11.68%, 9.58% (2018) and 9.62%, 10.66% (2019), and the volume of fragrant pear increased by 8.96%, 11.89% (2018) and 11.96%, 15.54% (2019). Li et al. (2011) showed that the fruit shape of fragrant pear with fruit shape index less than 1.12 was nearly round, and that greater than 1.29 was long oval. The fruit shape between 1.12 and 1.29 was oval, and the oval was better. The fruit shape of fragrant pear treated with control B was mostly nearly round, while the fruit shape of fragrant pear irrigated with MB and IB was mostly oval and upright. The results indicate that activated brackish water can not only effectively improve the volume of fragrant pear fruit, but also improve the fruit shape of

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
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fragrant pear to a certain extent, which may be due to the fact that activated brackish water irrigation could play a role similar to plant growth hormone to some extent (Boe and Salunkhe, 1963; Qiu et al., 2011), and can effectively regulate the improvement of fruit shape of fragrant pear.

Table 1. *Fruit shape of fragrant pear irrigated with activated brackish water. B, MB and IB represent brackish water, magnetized brackish water and ionized brackish water, respectively*

Year	Treatment	Longitudinal diameter (mm)	Transverse diameter (mm)	Fruit shape index	Fruit tree volume (cm^3)
2018	B	63.46b	56.55a	1.12b	116.98b
	MB	67.75a	54.06c	1.25a	127.45a
	IB	68.04a	55.33b	1.23a	130.89a
2019	B	64.53b	58.24a	1.11b	123.57c
	MB	69.21a	56.98b	1.21a	138.34b
	IB	70.23a	57.28b	1.23a	142.77a
Significance					
Treatment		**	***	**	***
Year		*	**	*	***
Treatment×Year		**	***	**	***

Different letters within a column indicate significant differences among all treatments at P < 0.05. *, **And *** represent significant differences at the levels of P < 0.05, P < 0.01 and P < 0.01, respectively

Effects of activated brackish water irrigation on yield and water use efficiency of fragrant pear

Fig. 4 showed the yield and water use efficiency of fragrant pear under activated brackish water irrigation. The activated brackish water irrigation could significantly improve the yield and water use efficiency of fragrant pear ($P < 0.05$). Compared with control B treatment, the yield of fragrant pear irrigated with MB and IB increased by 11.20%, 12.47% (2018) and 22.22%, 25.08% (2019), and water use efficiency increased by 12.97%, 14.15% (2018) and 25.24%, 26.21% (2019). Zhang et al. (2020) showed that the yield of winter wheat irrigated with magnetized water increased by 8.99% and the water use efficiency increased by 5.07%, and Zhu and Li (2020) found that the yield of single tomato irrigated with ionized water increased by 19.87% and the irrigation water use efficiency increased by 37.69%, which were consistent with the results of this study. The results indicate that activated brackish water irrigation can effectively improve the yield and water use efficiency of fragrant pear. On the one hand, activated brackish water irrigation can improve the availability of soil water and nutrients (Li et al., 2020a), which is conducive to the absorption and utilization of the roots of fragrant pear fruit trees (Mostafa et al., 2016), on the other hand, activated brackish water improves the water molecular activity. It is beneficial to promote the absorption and utilization of light energy by fragrant pear leaves (Liu et al., 2019), promote the transformation of photosynthetic substances (Liu et al., 2016), and finally improve the yield and water use efficiency of fragrant pear.

Effect of activated brackish water irrigation on quality of fragrant pear

The quality grade of fragrant pear is determined by the single fruit weight, hardness, soluble solid content, total acid content and vitamin C content of fragrant pear. As can be seen from *Table 2*, activated brackish water irrigation had a significant effect on the quality of fragrant pear ($P < 0.05$). Under activated brackish water irrigation, the fruit

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surface of fragrant pear was smooth, the peel was fine, the stem was intact, and the fruit was yellow-green. The single fruit weight of fragrant pear irrigated with brackish water was less than 120 g, which could only reach the standard of first-grade fragrant pear, while the single fruit weight of fragrant pear irrigated with activated brackish water was between 120 g and 160 g, which reached the standard of super-grade fragrant pear. Compared with control B treatment, the single fruit weight of fragrant pear irrigated with MB and IB increased by 15.96%, 19.07% (2018) and 20.33%, 22.62% (2019), hardness decreased by 21.69%, 23.90% (2018) and 20.65%, 21.61% (2019), soluble solids increased by 4.41%, 4.25% (2018) and 8.48%, 8.64% (2019), total acid decreased by 13.01%, 12.33% (2018) and 16.78%, 17.72% (2019), and the content of vitamin C decreased slightly, but not significantly ($P > 0.05$). This result is consistent with the result of Jia et al. (2019) using magnetized water to irrigate Lingwu winter jujube. Thus, activated brackish water irrigation can effectively improve the fruit soluble solid content, reduce the total acid content and improve the taste of fragrant pear to a certain extent. This is mainly because activated brackish water irrigation can improve the utilization rate of light energy of fragrant pear fruit trees, affect the allocation of photosynthetic products (Cai et al., 2020), and then improve the sugar acid balance inside the fruit (Wei et al., 2020).

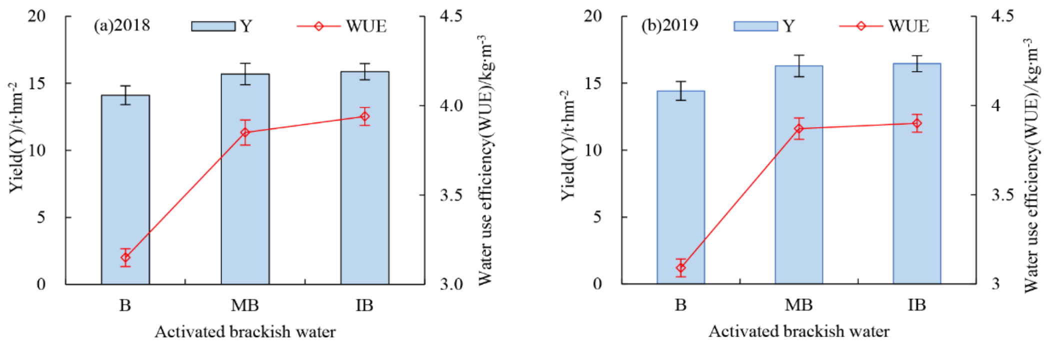

Figure 4. *Yield and water use efficiency of fragrant pear under activated brackish water irrigation. B, MB and IB represent brackish water, magnetized brackish water and ionized brackish water, respectively. The error bars represent standard deviations*

Table 2. *The fruit quality index of fragrant pear under activated brackish water irrigation. B, MB and IB represent brackish water, magnetized brackish water and ionized brackish water, respectively*

Year	Treatment	Single fruit weight (g)	Solidity ($kg \cdot cm^{-2}$)	Soluble solids (%)	Total acidity (%)	Vitamin C ($mg \cdot kg^{-1}$)
2018	B	113.76b	5.44a	12.24b	0.44a	6.10a
	MB	131.92a	4.26b	12.78a	0.38b	6.05a
	IB	135.45a	4.14b	12.76a	0.38b	6.07a
2019	B	118.43b	5.23a	12.38b	0.43a	6.50a
	MB	142.51a	4.15b	13.43a	0.36b	6.42a
	IB	145.22a	4.10b	13.45a	0.35b	6.45a
Significance						
Treatment		**	**	**	**	NS
Year		*	*	**	*	NS
Treatment×Year		***	**	***	**	NS

Different letters within a column indicate significant differences among all treatments at P < 0.05. *, **And *** represent significant differences at the levels of P < 0.05, P < 0.01 and P < 0.01, respectively, and NS represents no significant difference (P > 0.05)

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Conclusions

In this study, the effects of activated brackish water irrigation on the growth, fruit shape, yield, quality and water use efficiency of fragrant pear trees aged 15 years were studied through a two-year field irrigation experiments. The main conclusions are as follows:

(1) The activated brackish water irrigation can effectively improve the soil water content. During the growth period, the soil water content of the main root of fragrant pear fruit trees increases by 13.07%-28.15%.

(2) The maximum new shoot length of fragrant pear fruit trees irrigated with activated brackish water increased by 17.87%-51.12%, the fruit volume increased by 8.96%-15.54%, and the fruit shape of fragrant pear tended to be oval.

(3) Activated brackish water irrigation can not only improve the yield and water use efficiency of fragrant pear, but also improve the soluble solid content, reduce the total acid content and improve the taste of fragrant pear.

Generally speaking, in arid areas where fresh water is scarce, using activated brackish water instead of brackish water to irrigate fragrant pear can obtain a higher yield and quality. However, the optimal amount of irrigation and fertilization of fragrant pear irrigated with activated brackish water need to be further studied.

Acknowledgements. This study was funded by the National Natural Science Foundation of China (41830754 and 52179042).

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