

# The corps' growth with different water-saving irrigation conditions in new reclamation areas along the coast of Jiangsu

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**Abstract.** This study performed a quantitative evaluation of the impact of the corps' growth with different water-saving irrigation conditions in new reclamation areas along the coast of Jiangsu. In this work, the yield and the amount of irrigation water of corps' (watermelon, green pepper, and rice) with different water-saving irrigation modes were investigated. The results indicate that the drip-irrigation and micro-spray irrigation can observably reduce the amount of irrigation-water. With respect to normal irrigation, the rate of water-saving is 39.2%. At the same time, there's been some improvement in the yield of corps. Water-saving irrigation can be accepted as an important means for alleviating the shortage of fresh water resources in the new reclamation.

## 1 Introduction

Water scarcity is increasing worldwide, especially in water-stressed regions, and can be attributed to a combination of factors, such as climate change, population growth, expanding irrigated agriculture, industrial growth and economic development[1]. In the Eastern China Plain (especially the coastal areas of Jiangsu), climate change is causing a reduction in regional water resources, which manifested by increasing temperature, erosion of sea water and persistently high evaporation[2]. On the other hand, demand for water is increasing due to economic development, which in turn is increasing competition and conflict over water and the discrepancy between the supply of and demand for water is growing[3-5]. On account of the shortage of land resources, a large amount of reclamation has been carried out on the coastal tidal flats in Jiangsu province to increase the land area. Because of the high salt content in the soil in the early stage of reclamation, it is not suitable for corps to grow, and a large amount of fresh water is needed for desalination. With the increasing competition for water from non-agricultural sectors, such as urbanization, tourism industry and ecosystem services, it is essential to reduce the use of irrigation water in agricultural production in water-stressed regions. Especially in the coastal areas of Jiangsu, the water-saving irrigation technique is essential to ensure the normal development of agriculture in the new reclamation area, and to reduce the threats of regional water security and ecosystems[6-7].

In general, the research on corps' water-saving irrigation technology at abroad was mainly focused on the effects of different irrigation techniques on corps'

yield. There were few studies on the growth of corps under water-saving irrigation condition in new reclamation areas along the coast of Jiangsu, especially on the effects of different water-saving irrigation modes. Based on the above studies, this paper presents research on the micro spray and drip irrigation of greenhouses watermelon, the drip irrigation of greenhouses green peppers, water-saving and irrigation-controlling technique of rice. The results are of great significance for improving water-saving cultivation technology systems, and providing guidance regarding the efficient utilization of water resources in the new reclamation areas along the coast of Jiangsu.

## 2 Material and methods

### 2.1 Experimental Site

Jiangsu coastal area is bounded by Shandong Province in the north and reaches the Yangtze River estuary in the south, with a total length of 1039.7 km. The whole area is flat with elevation of 2.0 ~ 5.1 meters (Yellow River elevation system), except Yuntai mountain and other hills. The ground slope is below 1/10000. The area is formed by the siltation of the Yangtze River, the ancient Yellow River, the Huai River and the Yellow Sea. The city of Dongtai is located on the coast of the Yellow sea, with a coastline of 85 km. The average temperature is 16.1 °C, the extreme minimum temperature is -11.8 °C, the extreme maximum temperature is 38.8 °C. With the influence of marine climate, it has a moderate climate, and the frost-free period is 220 days. The average annual precipitation is 1075.8 mm, and concentrates in June to September. The soil is sandy loam. The temperature of experimental site varies widely from day to night. This

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study is arranged at dongchuan farm, located at 120°51'E, 32°59'N. The soil is progressive tidal flat. The physical

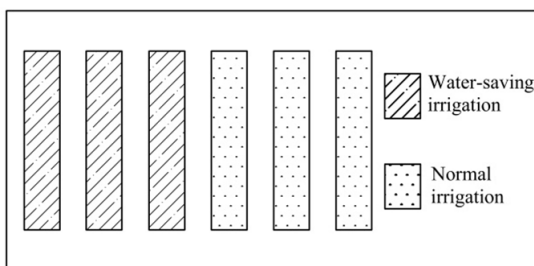
and chemical properties of soil in each test area before the test demonstrate in the Table 1.

**Table 1.** The physical and chemical properties of soil in each test area before the test (0-20cm)

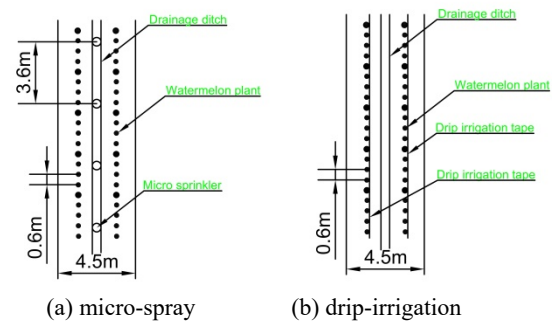
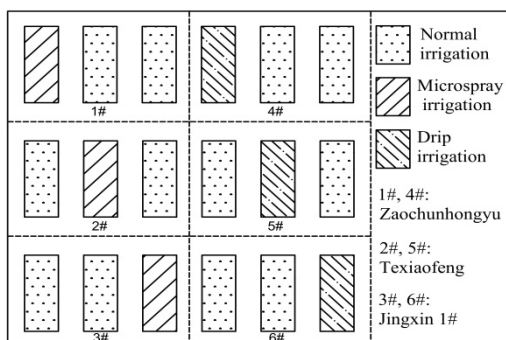
Test area	Total salt /( $\text{g}\cdot\text{kg}^{-1}$ )	pH	Soil particle diameter/%			Organic matter /( $\text{g}\cdot\text{kg}^{-1}$ )	Volume-weight /( $\text{g}\cdot\text{cm}^{-3}$ )
			sand	silt	cosmid		
Greenhouse watermelon	3.07	8.23	37.1	62.6	0.3	9.3	1.37
Greenhouse green pepper	2.16	8.14	29.9	69.3	0.8	11.0	1.34
Rice	1.47	8.11	16.8	81.6	1.6	12.7	1.30

## 2.2 Experimental Design

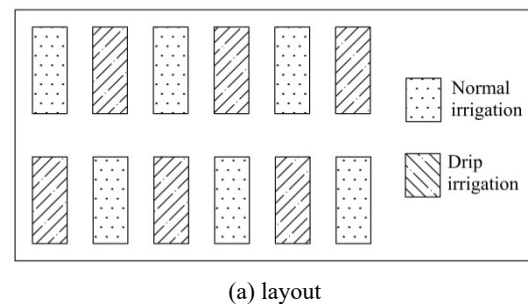
The different water-saving irrigation techniques are adopted, according to the different salt content of the soil in the new reclamation flats in the coastal areas of Jiangsu Province. The drip irrigation technique is adopted to plant green pepper in greenhouse, when the soil salinity is below 2‰. The water-saving and irrigation-controlling technique with rice and wheat crop rotation is adopted to plant rice, when the soil salinity is between 2‰ to 3‰. The drip irrigation and microspray irrigation technique are adopted to plant greenhouse watermelon, when the soil salinity is between 3‰ to 4‰. The cultivated area of greenhouse watermelon, greenhouse green pepper, rice is 520 arce, 116 arce, and 490 arce. The results can be used to study the corps yield's differentiation on account of water-saving irrigation and normal irrigation. The Zaochunhongyu, Texiaofeng, and Jingxin 1# are chosen as the variety of greenhouse watermelon. The Huaidao 5# is chosen as the variety of rice. The Sujiao 5# is chosen as the variety of greenhouse green peppers. The layout and irrigation modes of corps are showed in Fig. 1 – Fig. 4.



**Fig. 1.** The layout of rice test area

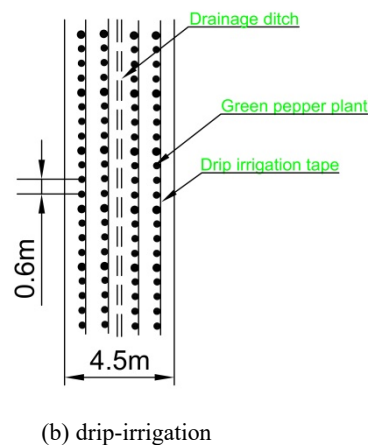


**Fig. 3.** The irrigation modes of watermelon test area



(a) layout

**Fig. 2.** The layout of watermelon test area



**Fig. 4.** The layout and irrigation mode of green pepper test area

## 3 Results and discussion

Throughout the growing process of corps, the total amount of irrigation water was calculated accurately in

each test field[8]. The water metering devices were installed on the main water supply pipes to calculate the total amount of irrigation water of corps' whole growth period, including watermelon and green pepper, in the test area of micro-irrigation. On the other hand, the water metering devices were installed at the intake in the test area of rice. The total amount of irrigation water of rice

was calculated by the measurement of the area across water, the water flow rate, and the irrigation time. The amount of irrigation water of corps' (watermelon, green pepper, and rice) each time was showed in the Table 2. And the yield of corps' (watermelon, green pepper, and rice) with water-saving irrigation and normal irrigation was show in Table 3.

**Table 2.** The amount of irrigation water of corps' (watermelon, green pepper, and rice)

Variety of corps	Irrigation modes	The date and amount of irrigation(m <sup>3</sup> per arce)														Summ-ation
		17 <sup>th</sup> Jan.	26 <sup>th</sup> Jan.	29 <sup>th</sup> Jan.	17 <sup>th</sup> Feb.	5 <sup>th</sup> Mar	12 <sup>th</sup> A pr.									
Zaochun hongyu	Date of irrigation															-
	Micro-spray	2.35	1.76	1.05	1.23	2.04	1.31									9.74
	Drip-irrigation	1.61	1.12	0.87	0.83	1.35	0.75									6.53
	Normal-irrigation	4.93	3.85	2.34	2.12	4.30	2.36									19.9
Texiaofeng	Date of irrigation	15 <sup>th</sup> Jan.	25 <sup>th</sup> Jan n.	28 <sup>th</sup> Jan n.	15 <sup>th</sup> Feb.	26 <sup>th</sup> Feb.	8 <sup>th</sup> Mar	17 <sup>th</sup> A pr.								-
	Micro-spray	2.17	1.53	0.85	1.03	1.63	0.68	0.97								8.86
	Drip-irrigation	1.15	1.07	0.63	0.57	1.27	0.48	0.81								5.98
	Normal-irrigation	3.27	2.98	1.75	1.83	3.87	1.35	2.82								17.87
Jingxin 1#	Date of irrigation	24 <sup>th</sup> Jan n.	28 <sup>th</sup> Jan n.	5 <sup>th</sup> Feb.	14 <sup>th</sup> Feb.	26 <sup>th</sup> Feb.	6 <sup>th</sup> Mar	14 <sup>th</sup> A pr.	19 <sup>th</sup> A pr.							-
	Micro-spray	1.78	1.53	1.57	1.28	1.35	0.87	1.19	1.85							11.42
	Drip-irrigation	1.25	1.07	1.01	0.85	1.12	0.53	0.79	1.73							8.35
	Normal-irrigation	2.47	3.21	3.03	2.68	2.83	1.85	2.47	1.31							19.85
Huaidao 5#	Date of irrigation	18 <sup>th</sup> Jun.	25 <sup>th</sup> Jun.	30 <sup>th</sup> Jun.	8 <sup>th</sup> Jul.	21 <sup>st</sup> Jul.	26 <sup>th</sup> Jul	3 <sup>rd</sup> Aug	7 <sup>th</sup> Aug	26 <sup>th</sup> A ug	2 <sup>nd</sup> Sep.	6 <sup>th</sup> Sep.	21 <sup>st</sup> Sep.	2 <sup>nd</sup> Oct.		-
	Water-saving irrigation	31.2	26.5	24.7	29.3	32.5	36.7	35.3	25.4	23.1	24.5	26.3	21.5	26.8		363.8
	Normal-irrigation	42.1	36.4	37.1	44.5	46.7	49.3	48.5	36.3	34.6	35.7	32.1	30.5	23.5		497.3
Sujiao 5#	Date of irrigation	23 <sup>rd</sup> Mar	1 <sup>st</sup> Apr.	14 <sup>th</sup> Apr.	2 <sup>nd</sup> May											-
	Drip-irrigation	19.7	8.3	6.9	6.3											41.2
	Normal-irrigation	30.1	15.8	12.3	9.6											67.8

**Table 3.** The yield of corps' (watermelon, green pepper, and rice) with water-saving irrigation and normal irrigation

Corps	Variety	Irrigation modes	The measured value of yield(Kg/acre)						The mean value of yield(Kg/acre)
Water-melon	Zaochunhongyu	Micro-spray	3780	3750	3853	3910	3890	3809	3832
		Drip-irrigation	4250	4297	4310	4335	4307	4283	4297
		Normal-irrigation	3670	3650	3665	3730	3765	3618	3683
	Texiaofeng	Micro-spray	3790	3680	3710	3815	3665	3714	3729
		Drip-irrigation	4150	4023	4095	3985	4135	4092	4080
		Normal-irrigation	3585	3702	3650	3694	3585	3606	3637
	Jingxin 1#	Micro-spray	4350	4270	4345	4290	4210	4185	4275
		Drip-irrigation	4585	4692	4603	4540	4670	4702	4632
		Normal-irrigation	4095	4135	4210	4175	4080	4241	4156
Rice	Huaidao 5#	Water-saving irrigation	670.0	662.5	701.5	727.5	707.5	656.0	687.5
		Normal-irrigation	647.5	685.0	670.0	678.0	635.0	665.5	663.5
Green pepper	Sujiao 5#	Drip-irrigation	4180	4350	4273	4198	4283	4310	4266
		Normal-irrigation	3985	4013	4274	4130	4046	3963	4069

In terms of the yield per acre of greenhouse watermelon, it arranging from high to low respectively

are Jingxin 1#, Zaochunhongyu, and Texiaofeng under the same irrigation conditions. In terms of the yield per

acre of greenhouse watermelon, drip irrigation is higher than micro-spray. The preliminary result of research shows that, drip irrigation is suitable for planting crops in fixed plant and fixed line, such as watermelon, tomato and so on. Micro-spray irrigation is suitable for spreading crops, such as leek, celery and so on. From the perspective of irrigation-water capacity of greenhouse watermelon, it demonstrates that drip-irrigation mode is the lowest, and the micro-spray mode takes second place. The normal irrigation needs the largest amount of water. Compared with normal irrigation, the yield-improving effect of drip-irrigation is more prominent than the micro-spray irrigation, among three varieties of watermelon.

There was no significant difference in yield between normal irrigation and water-saving irrigation for rice cultivation. At the same time, the potential of water-saving is huge. The irrigation water capacity per arce of water-saving differs with 133.5 m<sup>3</sup>, and the rate of discrepancy reaches 26.8%. The yield per acre of Huaidao 5 # with water-saving irrigation demonstrates 24 kg higher than normal irrigation.

The yield per acre of Sujiao 5 # with drip-irrigation demonstrates 197 kg higher than normal irrigation. To the contrary, the irrigation water capacity per arce of drip-irrigation reduces 26.6 m<sup>3</sup> than the normal irrigation. The rate of water-saving is 39.2%, with respect to normal irrigation.

## 4 Conclusion

The aim of this paper is to study the corps' growth with different water-saving irrigation conditions in new reclamation areas along the coast of Jiangsu, to provide initial guidance regarding the efficient utilization of water resources in the new reclamation areas along the coast of Jiangsu. Three irrigation modes (drip-irrigation, micro-spray irrigation, normal irrigation) have been presented in this study. Comparison to normal irrigation mode, the results obtained with water-saving irrigation modes proved that the drip-irrigation and micro-spray irrigation can observably reduce the amount of irrigation-water. At the same time, there's been some improvement in the yield of corps. The results show that the water-saving irrigation can signally alleviate the shortage of fresh water resources in the new reclamation.

In future, we will carry through the large-scale popularization of various water-saving irrigation technologies in the new reclamation areas along the coast of Jiangsu, in order to improve water-saving cultivation technology systems, and provide guidance regarding the efficient utilization of water resources in the new reclamation areas along the coast of Jiangsu.

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