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EFFECTS OF WATER USE IN DRIP IRRIGATION AND SURFACE IRRIGATION METHODS ON YIELD AND VEGETATIVE CHARACTERISTICS ON DATE PALM

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ABSTRACT

Iran agricultural production has tripled during the past two decades (19 million tons in 1978 and 68 million tons in 2002). However, this rate of growth in production may not meet the projected goal of 100 million tons by the year 2015. To meet that goal, it is imperative to increase water use efficiency (WUE). This study carried out on the six years old date palm (*Phoenix dactylifera*) cv. Piarom, in Iran (Hormozgan province) during 1996-2000. In this study, two irrigation systems and two water use were compared in randomized complete block design (RCBD) with factorial arrangement. There were three replications, where each replication contained four date palm trees. Treatment combinations were: A_1= drip irrigation method and water use based on 75% evaporation of class A pan, A_2= drip irrigation method and water use based on 100% evaporation of class A pan, B_1= surface irrigation method and water use based on 75% evaporation of class A pan, B_2= Surface irrigation method and water use based on 75% evaporation of class A pan. Water use was calculated based on evapotranspiration (ETP) class A pan method. Irrigation interval in drip irrigation was two days and surface irrigation was weekly. The results showed that there were no significant effects of treatments on the yield and the leaf number but there was significant effect on the leaflets number, shade perimeter, trunk perimeter. So due to many advantages like efficient use of water, low cost, easy to manage and easy to automate, drip irrigation method is recommended as the best irrigation method for date palm plantation in southern Iran.

Keywords: *Phoenix dactylifera*, shade perimeter, trunk perimeter, leaf number, leaflet number, Piarom

INTRODUCTION

Date palm is among the most important and strategic agricultural crops. More than 85% production is contributed from Egypt, Iran, Iraq, Saudi Arabia and Pakistan. Sharp increase in population is leading to increased demand for agricultural commodities. This in turn increases the water consumption. Thus, the balance between water security and food security must be considered and for reaching such balance, efforts must be made, and one of the major options is increasing water use efficiency (WUE). Like any other fruit tree, Date palm needs sufficiency water of acceptable quality to reach its potential yield. Water is the limiting factor for crop

production in arid and semi-arid areas. This limitation has led to development of some effective methods for utilization of water in some arid areas. Different irrigation techniques are available to irrigate crops, but not all of them are suitable for date palm irrigation. Drip and surface methods are important and each has its own advantages and disadvantages. Identification of the best irrigation interval and depth in trickle irrigation method indicated that the irrigation interval had not any significant difference on the yield, height, trunk perimeter, leaf number, canopy diameter and canopy percentage (Daneshnia, 1999). Effect of irrigation on growth, yield and fruit quality of dry dates grown at Asswan with cv. Sakkoti indicated that the leaf growth, leaf size, increased with increasing irrigation (Hussein and Hussein, 1983). It was noted that the palms in the wet plots (received heavy irrigation throughout the season) grew at the rate of 4.25 to 4.75 cm per day during this period. While the rate of growth in the dry plots (were irrigated very sparingly during the period from June through October) was reduced to between 3.5 and 4.0 cm per day. This represents a reduction of only about 20% in rate of growth (Walter and Crawford, 1945).The rate of leaf elongation studied in relation to soil moisture deficiency. When the soil moisture in any portion of the rooting zone of the palm has become depleted to the extent that fruit growth has been reduced. The rate of leaf elongation has become less than that for adequately irrigated palms. Greater the deficiency of soil moisture for fruit growth, greater has been the reduction in rate of leaf elongation (Aldrich, 1942).The influence of irrigation of the Maktoom date showed that the palms were uniform in height and number of leaves. They carried an average of 77 leaves at the initiation of the experiment. About 30 of the oldest leaves had been seriously damaged due to freezing during 1948 and 1949. During 1949, the palms receiving frequent irrigation produced an average of 24.5 leaves and 6-10 old damaged leaves died. Whereas palms irrigated infrequently produced, only 20 leaves and 25 old leaves died (Sharples and Hilgeman, 1951). Withholding moisture during the developing and ripening period markedly reduces the percentage of high-grade fruit, as well as, reducing total yield about 17.5%. It is of particular interest to note that reducing irrigation did not reduce loss from drop but if anything, increased it slightly under the condition of this experiment (Walter and Crawford, 1945). Quantities of water made available to date-palm around the world were showed that water requirement in Algeria, California, Egypt, India, Iraq, Israel, Morocco, South Africa, Tunisia is equal to 15000-35000, 27000-36000, 22300, 22000-25000, 15000-20000, 25000-32000, 13000-20000, 25000, 23600 m^3/ha, respectively (Zaid, 1999).

MATERIALS AND METHODS

The study was carried out in Hormozgan province in Iran during 1994-2001. In this study, two water use and two irrigation systems were compared in a randomized complete block design (RCBD) in a factorial arrangement with three replications. Each replication consisted of four date palm trees. Treatment combinations were including

A_1= Drip irrigation method and water use based on 75% evaporation of class A pan

A_2= Drip irrigation method and water use based on 100% evaporation of class A pan

B_1=Surface irrigation method and water use based on 75% evaporation of class A pan

B_2= Surface irrigation method and water use based on 75% evaporation of class A pan

Water use was calculated based on ETP class A pan method by following formulas:

$ETo= Ep\times Kp$

$ETc= ETo \times Kc$

$I=ETc \times S / \eta$

where,

Eto = Reference evapotranspiration

Ep = Pan evaporation

Kp = Pan coefficient

Kc = crop coefficient

I = Irrigation requirement

S = surface
ETc = Crop evapotranspiration
Ɗ= efficiency of irrigation system

Irrigation interval in drip irrigation was two days and surface irrigation was applied weekly. The variables tested during the experiment were yield and leaves number, leaflets number, shade perimeter, trunk perimeter.

RESULTS AND DISCUSSION

The results of our 7-years studies showed that water requirement in treatments of 1, 2, 3 and 4 of 25, 32, 42 and 58 m^3/tree, respectively. In addition, the results showed non-significant effect of treatments on the yield, quality of fruit.

Water use in treatments is shown in Table 3. Results showed that water use in treatments have not any significant difference on yield. Nevertheless, water use rate in treatment 4 was 2 times of treatment 1. It means that with only about 1/2water use, we can have same yield with high quantity and quality and additional water is used for development of area under cultivation.

The results that showed there were no significant effects of treatments on the yield and the leaves number but there was significant effect on the leaflets number, shade perimeter, trunk perimeter.

So due to many advantages of drip irrigation method such as more efficient use of water, low cost, easy to schedule manage and easy to automate, it is recommended as the best irrigation method for date palm plantation in southern of Iran

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TABLES

Table 1: Effects of water use in drip irrigation and surface irrigation methods on yield and vegetative characteristics on date-palm (cv. Piarom)

Trait	Treatment				MS	Prob.
	1	2	3	4		
Yield	69.8	70.1	75.8	67.2	17.921	n.s
Leaves number	82.8	73.5	82.5	83.2	8.507	n.s
Leaflets number /leave	144.1	147.8	148.4	147.9	612.563	**
Shade perimeter	24.4	23.3	26.0	25.8	17.222	**
Trunk perimeter	2.85	2.71	2.75	2.85	0.076	**

n.s=not significant
**=1% significant probability level

Table 2: Mean of climatological data

month	**Min. Temp. (°c)**	**Max. Temp. (°c)**	**Mean. Temp. (°c)**	**Evap. (mm)**	**Precep. (mm)**
Jan	-1.8	25	11.6	30.1	51
Feb	6	19.1	12.5	41.2	48
Mar	9	23	16.5	31.6	36.5
Apr	5.8	34.6	20.2	154.7	0
May	13.4	41	27.2	224.6	0
Jun	16.4	44.4	30.4	285	30
Jul	20.2	44.8	32.5	418.2	3
Aug	21.2	43.2	32.2	359	0
Sep	20	42.8	31.4	290	21.5
Oct	13.2	38	25.6	245	0
Nov	5.4	33	19.2	110.4	0
Dec	0.2	25.8	13	58.8	2.5

Table 3: Water use in the different treatment and different year (m^3/ha)

Year / **Treatment**	**1996**	**1997**	**1998**	**1999**	**2000**
1	3557	3635	3681	6256	7051
2	5039	4852	4914	8330	9376
3	6677	6427	6521	11092	12465
4	8906	8970	9017	14773	16567