



Research paper

**Effect of Irrigation Intervals on Growth and Yield of
Semi-dry Date Palm Cultivars in River Nile State,
Sudan**

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ABSTRACT

The experiment was conducted at Korgus area 17 km south of Abu Hamad in the River Nile State during two seasons (2005/6 and 2006/7) to study the effect of irrigation intervals on growth and yield of two semi-dry date palm cultivars; Mishrig Wad Laggai and Mishrig Wad Khateeb. The treatments were three irrigation intervals (10 days, 20 days and 30 days). The parameters studied were annual gain in leaves number per plant, plant height, plant stem diameter (cm) and yield (kg/tree). The results showed that the irrigation intervals had significant effect on all parameters measured. The 10 days irrigation interval gave the maximum mean values for all parameters in both seasons, followed by 20 days irrigation interval, whereas the 30 days irrigation interval gave the lowest values. The effect of irrigation intervals on plant stem diameter and yield showed significant difference between the two date palm cultivars, but the number of leaves per plant and plant height were not affected.

Keywords: *Date palm cultivars, growth, irrigation intervals, yield*

تأثير فترات الري على نمو وإنتاجية أصناف التمور شبه الجافة بولاية نهر النيل،

السودان

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أجريت التجربة بمنطقة كرقس التي تقع جنوب محلية أبو حمد (17 كيلومتر) بولاية نهر النيل خلال موسمي 2006/2005 و 2007/2006 بغرض دراسة أثر فترات الري على نمو وإنتاجية نوعين من أصناف النخيل شبه الجافة (مشرق ود لفاي ومشرق ود خطيب). كانت المعاملات هي فترات ري مختلفة (10 أيام، 20 يوماً و 30 يوماً). صفات النمو الخضري للاشجار التي تمت دراستها كانت مقدار الزيادة السنوية في طول النبات، محيط الساق، عدد الأوراق بالإضافة إلى إنتاجية النخلة بالكيلوجرام. نفذت التجربة بتصميم القطاعات كاملة العشوائية بثلاث مكررات. أظهرت النتائج أن لفترات الري تأثيرات معنوية في كل الصفات المقاسة. كما أعطت فترة الري كل 10 أيام أعلى المتوسطات لكل الصفات والإنتاجية للموسمين يتبعها فترة الري كل 20 يوماً وأخيراً فترة الري كل 30 يوماً والتي أعطت أقل قيم. أظهر تأثير فترات الري على الزيادة السنوية لمحيط ساق النبات فروق معنوية بين صنفين نخيل البلح، بينما لم تتأثر صفتي عدد الأوراق وطول النبات.

Introduction

Date palm (*Phoenix dactylifera L.*) has an important economic position in the Sudanese fruit production. The date palm is the principal horticultural crop of Northern Sudan. The number of date palms in River Nile State is estimated as one million trees, in an area of 5463.45 hectares. River Nile State is distinguished by soft and semi-dry cultivars like Mishrig Wad Khateeb and Mishrig Wad Laggai beside other dry cultivars (Sedig and Abd Alwahab, 1999).

The annual production of dates in River Nile State is estimated at about 27 thousand tons and the palm tree yield is about 30 Kg. The production is extremely low. However, it is possible for good cultivars of date palms, if provided by ideal technical packages to raise the production to about 100 kg or more (Sedig and Abd Alwahab, 1999). Most of date palm farmers in the Arab countries, where there are about 75% of the total date palm of the world, do not care much about irrigation. They believe that date palm trees can grow and bear fruits under drought and do not require irrigation. On the contrary, all the experiments and studies showed that date farming and development depend on irrigating the trees with enough water to fulfill their water requirement (Ibrahim, 2009).

Irrigation has generally proved its importance for the maintenance of regular cropping and good quality fruits of different date palm cultivars. The date palm like any other fruit tree requires enough water to compensate for the losses due to the soil surface evaporation and the transpiration from the leaves, as well as the amount that is needed during its growth and fruiting stages (Hussein and Hussein, 1983 and Gasium and Hameed, 2003). Date palms grow under desert climatic conditions and they are considered as drought resistant and salt tolerant as compared to other crops. However, it is equally important to irrigate the tree with sufficient amount of good quality water in order to produce acceptable yield and better fruit quality (Ibrahim, 2009 and Al Amoud *et al.*, 1999).

Date palm growth and yield are affected by both the magnitude of water deficit and the stage of growth subject to deficit. Insufficient water supply caused by prolonged irrigation intervals, and/or decreasing the available moisture in the soil, clearly inhibits plant growth (Scatter and Habib, 2007).

Nimir (1986) studied the effect of three irrigation intervals (10, 15 and 20 days) in combination with three irrigation water amounts (60, 75 and 90 mm per irrigation). He reported that plant height increased with short frequent and heavier irrigation. Makki and Mohamed (2005) cited that plant heights under 10 days interval were higher than those under 15 days interval. Therefore, the objective of the experiment was to study the effect of irrigation intervals on growth and yield of semi-dry date palm trees in River Nile State.

Materials and Methods

The experiments were conducted in River Nile State at "Korgus area" in the Eastern bank of the Nile and South of Abu Hamad. The region lies between latitudes 16-22° N, longitudes 33-50° E and generally characterized by long hot and dry summer with low relative humidity. The soil of the experimental site is clay loam near the Nile and sandy at the high terraces far from the Nile. The traditional (basin) surface irrigation system is considered the most applied irrigation system all over the River Nile State.

Irrigation treatments were 3 levels of irrigation intervals, 10 days, 20 days and 30 days. The parameters measured were annual gain in leaves number, plant height (cm), tree diameter (cm) and yield (kg/tree) for the two cultivars Mishrig Wad Laggai and Mishrig Wad Khateeb.

Tree height was measured from the terminal growing point down to the ground level by a tape. Stem diameter was determined at fixed marked points 1.3 m above ground levels.

The leaves were counted at the end of the season and at the beginning of the new season. Three leaves per tree were randomly selected after harvest in November, from the top, middle and lower parts of the tree. Small number of leaves was taken from the base, middle and terminal of the frond, mixed and dried for chemical analysis.

The design used was completely randomized block design. The data were statistically analyzed using SAS computer program.

Results and Discussion

As illustrated in Table (1), irrigation intervals showed significant effect on the number of leaves per plant for the two date palm cultivars. The largest annual gain in leaves number were obtained under 10 days irrigation interval, followed by 20 days interval, whereas the lowest annual gain in leaves number was recorded under 30 days irrigation interval in both seasons.

However, superiority of frequent irrigation over the other was reported by Saleem *et al.* (2005) who found that maximum plant height and number of leaves per plant was produced under short irrigation intervals.

Results depicted in Table (1) also showed significant effect of irrigation intervals on annual gain in plant height (cm) of the two date palm cultivars. The highest values of increment in plant height was obtained by 10 days irrigation interval, followed by the 20 days irrigation interval, and 30 days irrigation interval, for the two seasons. These results are in accordance with that obtained by Ahmed (1988) who reported a significant increase in plant height of 40 and 47% resulted from irrigation interval of 5 days compared to a long interval of 15 days.

Table 1: Mean effects of irrigation intervals on annual gain in leaves number, tree height (cm), tree diameter (cm) and on yield (kg) of the two date palm cultivars.

Season	Annual gain in leaves number		Annual gain in plant height (cm)		Annual gain in plant stem diameter (cm)		Yield (kg)	
	05/2006	06/2007	05/2006	06/2007	05/2006	06/2007	05/2006	06/2007
Irrig. Interv.								
10 days	2.1 a	2.5 a	9.0 a	11.5 a	18.5 a	19.9 a	124.4 a	115.1 a
20 days	0.9 b	2.1 b	6.8 b	8.1 b	16.4 b	17.5 b	115.03 ab	97.36 ab
30 days	0.6 c	1.3 c	5.9 b	7.1 b	14.6 c	15.2 c	106.48 b	87.04 b

Means in the same column with the same letters are not significantly different at 5% level

As presented in Table (1), irrigation intervals has significant effect on plant stem diameter (cm) in both seasons. The largest increase in plant stem diameter was obtained under the 10 days irrigation interval in the two seasons, followed by the 20 days irrigation interval, whereas the smallest plant stem diameter was recorded under the 30 days irrigation interval in both seasons. The superiority of the 10 days irrigation interval might be attributed to the fact that it provides the crop with adequate crop water requirement under the prevailing environmental conditions (hot, dry and high evaporation in the region). However, these results are in conformity with the results obtained by Mohammed (2007) and Amiri and Aghazadeh (2007).

Irrigation intervals showed potent influence on the yield (kg/tree) of the two date palm cultivars (Table 1). The highest yield was obtained under 10 days irrigation interval followed by 20 days irrigation interval, whereas the lowest yield was recorded under the 30 days irrigation interval in the two seasons. Frequent irrigation would however provide the crop with adequate moisture in the surface layer where most of the tree roots exist, thus resulting in better crop nourishment and consequently yield. The yield for both cultivars under various irrigation intervals is significantly different. The results obtained are in conformity with those reported by Ahmed (1988) who mentioned that short irrigation intervals increased plant yield.

The annual gain in number of leaves prediction equation depends on irrigation intervals (Fig. 1). The precision of the equation was (R^2) 0.988. Change of irrigation intervals from 10 days to 30 days, led to a decrease of annual gain in number of leaves by 0.653. Data in Table (2) shows the indirect relationship between annual gain in number of leaves and irrigation intervals which was significantly different ($p \leq 0.05$), whereas the correlation coefficient was -0.994 .

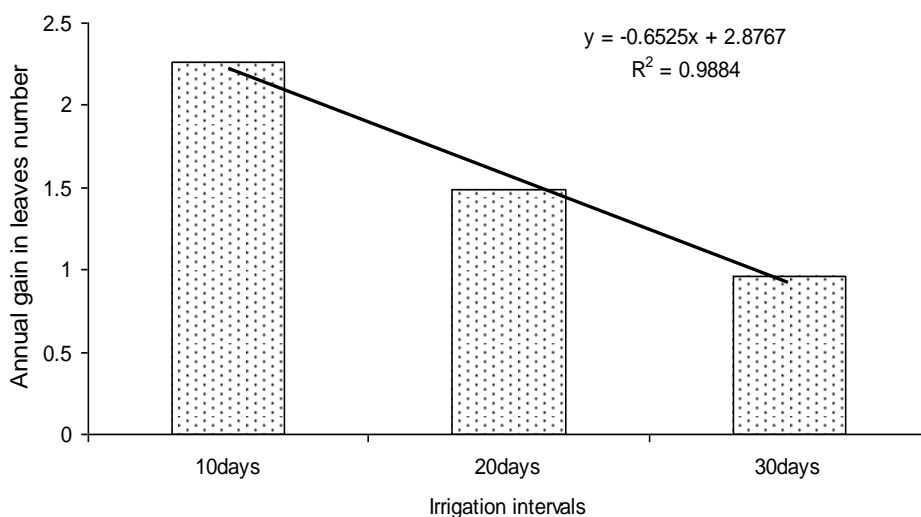


Fig. 1: Effect of irrigation intervals on annual gain in number of leaves per plant for the two date palm cultivars

Table 2: Correlations between irrigation intervals and growth parameters for two date palm cultivars

	Irrigation intervals	Number of leaves/tree	Tree height (cm)	Tree stem diameter (cm)	Tree yield (kg)
Irrigation intervals	1				
No. of leaves/tree	-0.994	1			
Tree height (cm)	-0.961	0.985	1		
Stem diameter (cm)	-0.999	0.997	0.969	1	
Yield (kg)	-0.995	0.999	0.984	0.997	1

As shown in Fig. 2. annual gain in plant height (cm) prediction equation depends on irrigation intervals. The precision of the equation was (R^2) 0.923. Change of irrigation intervals from 10 days to 30 days, led to a decrease of number of leaves by 1.9. Data in Table (2) shows the indirect relationship between annual gain in plant height (cm) and irrigation intervals with a correlation coefficient of -0.961 .

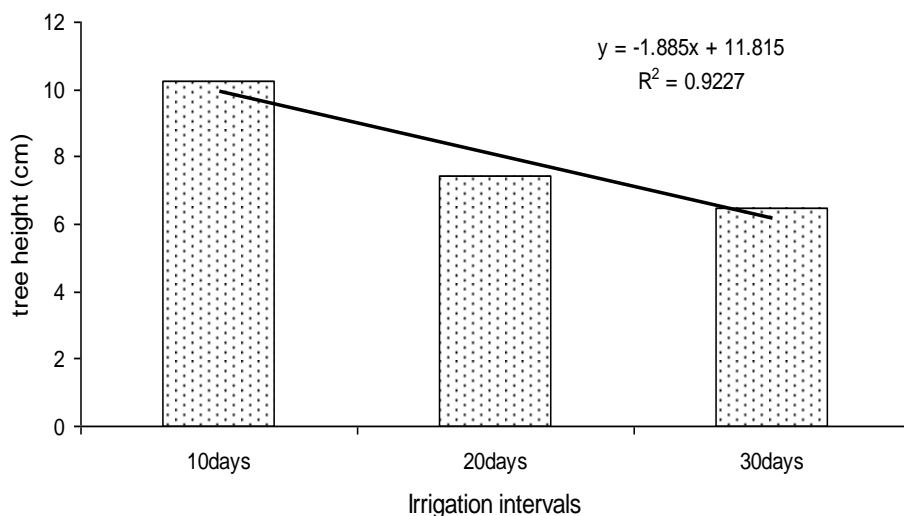


Fig. 2: Effect of irrigation intervals on annual gain in plant height for the two date palm cultivars

The annual plant stem diameter (cm) prediction equation depends on irrigation intervals (Fig. 3). The precision of the equation was (R^2) 0.999. Change of irrigation intervals from 10 days to 30 days led to a decrease of annual plant stem diameter by 2.17 cm. Data in Table (2) shows the indirect relationship between annual gain in plant stem diameter (cm) and irrigation intervals, with a correlation coefficient of -0.999 .

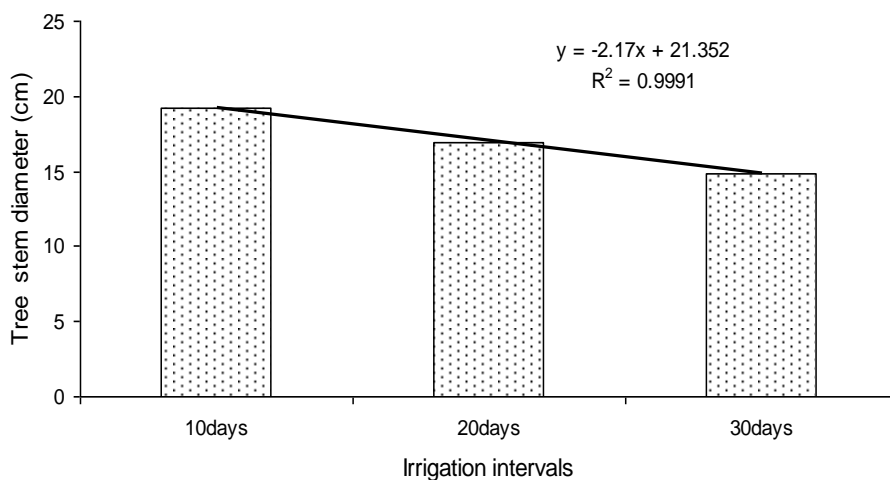


Fig. 3: Effect of irrigation intervals on annual gain in plant stem diameter for the two date palm cultivars

The tree yield (kg) prediction equation depends on irrigation intervals (Fig. 4.). The precision of the equation was (R^2) 0.978. Change of irrigation intervals from 10 days to 30 days, led to a decrease of number of leaves by 11.5. Data in Table (2) shows the indirect relationship between tree yield (kg) and irrigation intervals, with a correlation coefficient of – 0.995.

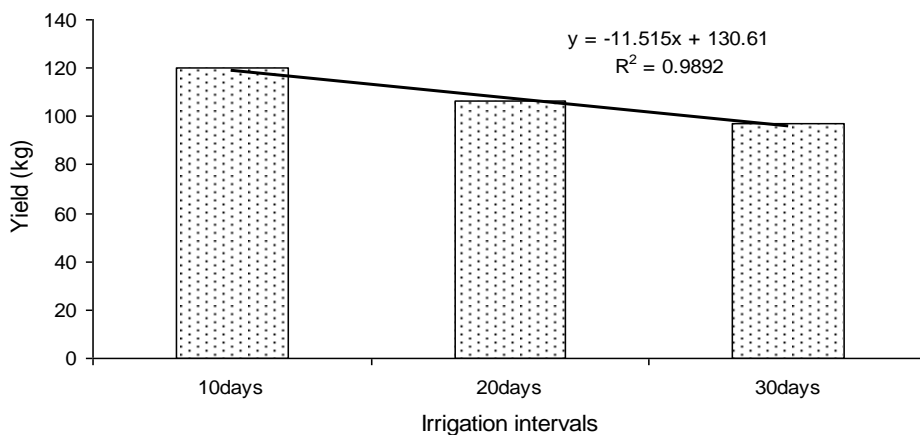


Fig. 4: Effect of irrigation intervals on plant yield for the two date palm Cultivars

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