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EFFECT OF WATER QUANTITIES AND IRRIGATION SYSTEMS ON TWO MUSKMELON CULTIVARS UNDER AL-HASSA CONDITIONS - KINGDOM OF Saudi Arabia.

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ABSTRACT

Studies on growth and yield of two muskmelon cultivars (Ananas and Chinese cvs) with using the different water quantities (100% and 75% of field capacity, and two irrigation systems (surface and drip irrigation) were carried out during two successive seasons (1999 and 2000). The results showed that using surface irrigation was in favor for producing the highest values of plant height, dry/fresh ratio %, number of branches/plant, leaf area/plant, number of leaves/plant number of fruits/plant, average fruit weight, fruit height, fruit diameter, total yield and T.S.S %, while the water quantity with 100% of field capacity gave the best results for all the vegetative growth and yield parameters.

However, the Ananas cultivar gave the best result, for all vegetative growth, and yield comparison with Chinese cultivars. While the interaction between cultivars and water quantities, showed that 100% water of field capacity gave the highest values for all vegetative growths, while Ananas cv with 100% water of field capacity was the best results for yield measures. However the treatment Chinese cultivar with surface irrigation gave the highest values for plant height, D/F ratio %, number of branches/plant, number of fruit/plant, fruit height and total yield kg/m^2, while the Chinese cultivar gave the best results with surface irrigation for fruit weight and fruit diameter in both seasons,. However, TSS% was the highest value with Ananas cultivar with drip irrigation.

Interaction between water quantities and irrigation system showed that the treatment 100% at field capacity with surface irrigation gave the highest values for all vegetative growths and yield parameters except TSS %, while TSS% was highest values after using 75% of field capacity with drip irrigation.

Finally, it is possibly suggested that surface irrigation with Ananas cultivar with 100% at field capacity could be useful for enhancing the yield at muskmelon. However, it can be concluded that the drip irrigation with 75 % of water field capacity was the recommended treatment for minimizing irrigation water quantity under Al-Hassa Oasis conditions.

INTRODUCTION

Muskmelon plants (*Cucumis melo* L.) is one of the most vegetative plants grown in the Kingdom of Saudi Arabia. Al-Hassa region is one of the largest agricultural areas in the Kingdom. Its common light textured soil is usually deficient of the macro-elements especially nitrogen (N) and phosphorus (Al-Taher 1999). Muskmelon plants are well grown in summer season and under Al-Hassa condition, however, different water quantities and irrigation systems gave positive effects on the growth characters and yield of different muskmelon cultivars. Many investigators studied that the

effects of different water quantities and irrigation systems on muskmelon plants. Al-Dakheel (2000) found that the interactions between volumes of water applied and irrigation systems produced the highest values for fresh weight, dry/fresh ratio %, fruit height and total yield of Hassawi muskmelon by using 100% field capacity with 25 cm sub-surface system. Camp *et al.* (1993) used two surface (surface a and b, either one or two tubes/bed) and one subsurface (subsurface 2, two tubes below each bed microirrigation treatments and application frequencies, high (three time per day) and low (one time per day) was evaluated for muskmelon production in the spring seasons, results showed that the highest yield with two tubes below each bed treatment was obtained. Mannini (1988) found that the shorter interval (3 days) combined with the 100% ETM (evapotranspiration) irrigation rate increased muskmelon yield (i.e. higher fruit number and fruit). In contrast, the longer interval (6 days) combined with the 100% ETM irrigation rate caused a significantly lower yield. Low irrigation rates (33%) resulted in higher yield. For cucumbers, the best yield response (both in fruit number and weight) was obtained with 15% ETM irrigation rate, Yamagami (1985) found that the best vegetative growth and yield of melon were obtained after using a vinyl tunnel and a tube irrigation system with the irrigation interval 4-6 days). Nagawiecka and Boron (1991) found that leaf water potential could be used as an index for determining cucumber crop water requirements; Moynihan and Haman (1992) found that the drip irrigation system was the best system with compared furrow irrigation on cucumber plants. On the other hand, Bhella (1985) found that the irrigation significantly increased leaf area of muskmelon Vas-Kovskayo (1989) found that the mean yield of muskmelon under rained condition in 32.4 t/ha, and under irrigation up to 60 t/ha, with mean sugar content of fruit is 9.6%, Yabe *et al*. (1981) found that the small amount of water during the vegetative muskmelon growth stage increased fruit weight and soluble solid. Paunel *et al*. (1984) mentioned that average yield was 21.4 t/ha with drip, compared with 17.6 t/ha. With sprinkler irrigation Buitelaar (1988) found that sprinkler irrigation gave higher fruits number/m^2, greater average fruit weight and higher melon yield/m^2 with compared surface and drip irrigation. Kashi (1984) mentioned that the maximum yield of muskmelon and enhanced soluble solid contents, were obtained with irrigation intervals of 6 and 8 days. Shani (1985) showed that the highest yield and longest root of muskmelon were obtained after using drip irrigation with infiltration model. This investigations were carried out to compare the effects of two irrigation systems and two water quantities on two muskmelon cultivars. It also aims to determine the optimum irrigation system and water quantity on two muskmelon cultivars to give best production of muskmelon plants under the condition of Al-Hassa Oasis.

MATERIALS AND METHODS

Two field experiments were carried out during the two successive seasons (summer) of 1999 and 2000, at the Agricultural and Veterinary Training and Research Station, King Faisal University, Al-Hassa, K.S.A. Two

cultivars (Chinese and Ananas) were used. Muskmelon plants transplanted on the 3rd and 7th of March 1999 and 2000, respectively. The experiment was completed in an open field of a sandy soil. The following table includes the major soluble physical and chemical properties of the experimental site, which were determined following the methods described in Rowell (1994).

Soil characters	Soil texture				EC dSm^{-1}	pH	N%	Ava.P. mg^{-1}	$CaCO_3$ %
	Sand	Silt	Clay	Class					
Values	96%	2%	2%	Sandy	1.6	7.8	0.002	5	7

Key: Refers to available phosphorus in the upper 50 cm of the field.

The irrigation treatments included in the experiment were two water quantities (100% and 75% of field capacity) and two irrigation systems (surface and drip irrigation) with two muskmelon cultivars (Ananas and Chinensis). A split split blocks design with 4 replicates was used. Main plots were irrigation systems while subplots were water quantities and sub-sub-plots were cultivars. Each plot had an area of 40 m^2, which was divided into 4 rows with 10 m length and 1 m width. The spacing between the plants was 80 cm, The irrigation water had a salinity of 2.1 dSm^{-1} and a sodium adsorption ratio (SAR) of 4.65. The normal cultural practices were followed according to Agricultural and Water Ministry recommendation. Ten plants were taken at random from each plot pre-harvest and determined plant height, dry/fresh weight %, number of branches per plant, leaf area per plant cm^2, number of leaves per plant, number of fruits per plant, average fruit weight fruit height, fruit diameter, total soluble solid (by handily refractometer) and total yield/m^2. The obtained data were statistically analyzed according to the procedure outlined by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

A. Water quantities

-Vegetative growth yield and yield quality.

Data presented in Table (1) and (2) showed that the best results for plant height, dry/fresh ratio %, number of branches/plant, leaf area, number of leaves/plant, number of fruit/plant, average fruit weight, fruit height, fruit diameter total yield kg/m^2 and TSS % were produced by treatment with 100% of field capacity. The results were in agreement with those of Bhella (1985) who found that the irrigation significantly increased stem length and diameter, leaf area in muskmelon plants. Chandler and Mangal (1983) found that the best muskmelon growth was obtained on plot irrigated at 0.9 pan evaporation coefficient (55.5 mm of irrigation 2 water).

The same results were obtained by Al-Dakheel (2000) who found that the treatment with 100% of field capacity gave the highest values for fresh weight (plant, plant height, leaf area, number of branches/plant, number of fruits/plant, fruit diameter and total yield. Mannini (1988) found that the shorter interval (3 days) combined with the 100% ETM (evapo-transpiration) irrigation rate increased muskmelon yield (i.e. higher fruit number and fruit. In contrast, long interval (6 days) combined with the 100%

ETM irrigation rate resulted, in a significantly lower yield, low irrigation rates (33%) resulted in higher yield of muskmelon. For cucumbers, the best yield response (both in fruit number and weight) was obtained with 150% ETM irrigation rate.

Table 1: Average of plant height (cm), dry/fresh weight ratio, number of branches/plant, leaf area and number of leaves/plant as affected by water quantities and cultivars average two seasons).

Characters Treatment	Plant height (cm)	Dry/fresh ratio %	Number of branches/ plant	leaf area (m^2)	No. of leaves/ plant
A. Water quantities					
1. 100%	105.16	17.50	3.2	141.08	45.02
2. 75%	97.91	14.91	3.2	139.50	41.58
F.test	**	**	N.S.	**	**
B. cultivars					
1. Ananas	107.08	16.66	3.30	146.58	46.33
2. Chinensis	100.00	15.75	3.11	129.00	40.25
F.Test	**	**	N.S.	**	**
C- Interaction					
1. Ananas					
- 100%	105	17.16	3.13	131.00	41.50
- 75%	94	14.33	3.10	127.00	39.00
2. Chinensis					
- 100%	112	17.83	3.40	151.16	48.50
- 75%	101	15.50	3.21	142.00	44.16
F. test	**	**	N.S	**	*

Table 2: Average of number of fruit/plant, average fruit weight, fruit height, fruit diameter, total yield (kg/m^2), and TSS % as affected by water quantities and cultivars (average two seasons).

Characters Treatment	No. of fruit/plant	Average fruit weight	Fruit height	Fruit diameter	Total yield	TSS %
A. Water quantities						
1. 100%	3.88	1.13	13.00	10.0]	4.35	7.97
2. 75%	3.40	0.9	11.91	8.66	3.28	7.67
F.test	*	*	*	*	*	*
B. cultivars						
1. Ananas	3.81	1.06	13.91	9.50	4.08	7.83
2.Chinensis	3.47	1.03	11.00	9.16	3.55	7.81
F.Test	*	N.S	*	N.S	*	N.S
C- Interaction						
1. Ananas						
- 100%	4.10	1.1	14.50	9.66	4.70	7.65
- 75%	3.53	0.98	13.33	8.66	3.46	7.98
2.Chinensis						
- 100%	3.66	1.11	11.50	10.33	4.00	7.70
- 75%	3.28	0.93	10.50	8.66	3.10	7.96
F. test	*	*	*	N.S	*	N.S

B. Cultivars:

- Vegetative growth - yield and yield quality

Data presented in Table (1) and (2) showed that the Ananas cultivar gave the highest values for all vegetative growth measurements and yield compared with Chinese cultivar. The same results were obtained by Mangal *et al*. (1987). Mannini (1988), Osorio (1987) and Warriner and Henderson (1989) on muskmelon plants.

C. Interaction between water quantities and cultivars:

Data in Table (1) and 2 showed that the treatment of Chinese cultivar with 100% of field capacity gave the highest values in all vegetative growth measurements while the best results for yield and yield quality were obtained after using Ananas cultivar with 100% of field capacity, while the highest value for TSS % was obtained with Ananas cultivar with 75% of field capacity. Similar results were obtained by Wacquant (1989) who found that in trials with cultivars vedrantous and Hermes, lowering the irrigation rate reduced yield of muskmelon. Yadav and Mangal (1984) found that the best treatment for yield of fruit quality were obtained by using Hary Madhu cv with irrigation at 0.9 PEC. Franco *et al*. (1997) found that yield of all cultivars (i.e. Delada, Gallium, Galor, Melina, Regal and Revigal) decreased with using irrigation water at 7.5 dsm^{-1}.

D. Irrigation Systems:

- Vegetative growth, yield and yield quality :

Data presented in Table (3) and (4) showed that the treatment of surface irrigation gave the best results for plant height, dry/fresh ratio %, number of branches/plant, leaf area, number of leaves/plant, number of fruit/plant, average fruit weight, fruit height, fruit diameter, total yield kg/m^2 and TSS % in average two seasons. Similar results were obtained by Bhella (1985) who found that drip irrigation system of melon gave the highest values for fruit weight, sugar content. Mannini *et al*. (1985) found that the highest total yields (number and weights) were given by the treatment applying the highest volume with drip irrigation.

E. Interaction between irrigation systems and cultivars vegetative growth yield and yield quality.

Data in Table (5) and (6) showed that the treatment of Chinese cultivar with surface irrigation gave the highest values for plant height, dry/fresh ratio %, number of branches/plant, leaf area, number of leaves/plant, average fruit weight, and fruit diameter, while the number of fruit, fruit height and total yield were significantly increased after using Ananas cv with surface irrigation, while the TSS % was highest values with Ananas cv with drip irrigation. These results are in agreement with those obtained by Bogle and Hartz (1986) who found that drip irrigation method at 60% of soil water depletion (SWD) increased the yield of muskmelon cv Perlit as compared with furrow irrigation. Paunel *et al*. (1984) found that the drip irrigation was compared with sprinkler irrigation on muskmelon cv. Ogen results showed that drip irrigation gave highest yield. Yabe *et al*. (1981) found that the small amount of water at the vegetative growth stage suppressed growth and increased yield of muskmelon cv. Earl. Buitelaar

(1988) found that the sprinkler irrigation gave higher fruit numbers/m^2, great average fruit weight and higher yield/m^2, of muskmelon cv. Haon. While drip irrigation had little effects on fruit numbers/m^2.

Table 3: Average of plant height (cm), dry/fresh weight ratio, number of branches/plant, leaf area and number of leaves/plant as affected by irrigation systems (average two seasons).

Characters Treatments	Plant height (cm)	Dry/fresh ratio %	No. of branches / plant	leaf area (m^2)	No. of leaves/plant
Irrigation System:					
1. Surface	111.66	17.00	3.30	138.73	43.83
2. Drip	95.41	15.41	3.11	136.83	42.75
F.test	**	*	N.S.	*	*
B. cultivars					
1. Ananas	107.08	16.66	3.30	146.58	46.33
2. Chinensis	100.00	15.75	3.11	129.00	40.25
F.Test	**	**	N.S.	**	**
C- Interaction					
1. Ananas					
- 100%	105	17.16	3.13	131.00	41.50
- 75%	94	14.33	3.10	127.00	39.00
2. Chinensis					
- 100%	112	17.83	3.40	151.16	48.50
- 75%	101	15.50	3.21	142.00	44.16
F. test	**	**	N.S	**	*

Table 4: Average of number of fruit/plant, average fruit weight, fruit height, fruit diameter, total yield (kg/m^2), and TSS % as affected by irrigation systems (average two seasons).

Characters Treatments	No. of fruit/plant	Average fruit weight	Fruit height	Fruit diameter	Total yield	TSS %
Irrigation systems						
1. Surface	3.70	1.12	12.83	9.41	4.12	8.04
2. Drip	3.59	0.97	12.08	9.25	3.50	7.60
F.test	N.S	*	*	N.S	*	*
B. cultivars						
1. Ananas	3.81	1.06	13.91	9.50	4.08	7.83
2.Chinensis	3.47	1.03	11.00	9.16	3.55	7.81
F.Test	*	N.S	*	N.S	*	N.S
C- Interaction						
1. Ananas						
- 100%	4.10	1.1	14.50	9.66	4.70	7.65
- 75%	3.53	0.98	13.33	8.66	3.46	7.98
2.Chinensis						
- 100%	3.66	1.11	11.50	10.33	4.00	7.70
- 75%	3.28	0.93	10.50	8.66	3.10	7.96
F. test	*	*	*	N.S	*	N.S

Table 5: Average of plant height (cm), dry/fresh weight ratio, number of branches/plant, leaf area and number of leaves/plant as affected by Interaction between cultivars and Irrigation Systems (average two seasons).

Characters / Treatment	Plant height (cm)	Dry/fresh ratio %	Number of branches/ plant	leaf area (m^2)	No. of leaves/plant
Interaction					
Ananas					
1. Surface	109	16.50	3.20	131.50	41.00
2. Drip	90	15.00	3.03	126.50	39.50
Chinensis					
1. Surface	114	17.50	3.41	147.00	43.00
2. Drip	100	15.83	3.20	146.00	41.00
F.test	**	*	N.S.	**	*

Table 6: Average of number of fruit/plant, average fruit weight, fruit height, fruit diameter, total yield kg/m^2, and TSS % as affected by interaction between cultivars and irrigation systems (average two seasons).

Characters Treatment	Number of fruit/plant	Average fruit weight	Fruit height	Fruit diameter	Total yield Kg/ml	TSS %
Interaction						
Ananas						
1. Surface	3.88	1.11	14.33	9.33	4.33	7.41
2. Drip	3.75	1.01	13.50	9.00	3.83	8.21
Chinensis						
1. Surface	3.51	1.13	11.33	9.50	3.91	7.80
2. Drip	3.41	0.93	10.66	9.50	3.18	7.86
F.Test	*	N.S	*	N.S	*	N.S

F. Interaction between water quantities and irrigation systems:

- Vegetative growth, yield and yield quality:

Data presented in Table (7) and (8) showed that the treatment 100% of field capacity with surface irrigation gave the best results for plant height, dry/fresh ratio %, number of branches/plant, leaf area, number of leaves/plant, number of fruit/plant, average fruit weight, fruit height, fruit diameter, and total yield kg/m^2 while TSS % was highest with 75% of field capacity with drip irrigation. Similar results were obtained by Kashi (1981) found that the maximum yields and enhanced soluble solid contents were obtained with irrigation intervals of 6 and 8 days. Number of fruit/plant and average fruit weight varied in different years. Traditional irrigation gave better results than modern irrigation.

Therefore 100% of field capacity with surface irrigation with Ananas cultivar were the most favorable treatments for the vegetative growth and yield of muskmelon. However, it can be concluded that the drip irrigation with 75 % of water field capacity is the recommended treatment for minimizing irrigation water quantity under Al-Hassa Oasis conditions.

Table 7: Average of plant height (cm), dry/fresh weight ratio, number of branches/plant, leaf area and number of leaves/plant as affected by Interaction between water quantities and irrigation systems (average two seasons).

Characters Treatment	Plant height (cm)	Dry/fresh ratio %	No. of branches /plant	leaf area (m^2)	No. of leaves/plant
100 %					
1.Surface	118.33	18.16	3.40	142.00	45.33
2. Drip	100.00	16.83	3.13	140.16	44.66
75%					
1. Surface	105.00	15.83	3.21	137.50	42.33
2. Drip	90.83	14.00	3.10	131.50	40.83
F.test	**	*	N.S.	**	*

Table 8: Average of number of fruit/plant, average fruit weight, fruit height, fruit diameter, total yield kg/m^2, and TSS % as affected by interaction between Interaction between water quantities and irrigation systems. (Average of two seasons).

Characters Treatments	Number of fruit/plant	Average fruit weight	Fruit height	Fruit diameter	Total yield	TSS %
100%						
1. Surface	3.95	1.21	13.16	10.16	4.70	7.45
2. Drip	3.81	1.05	12.83	9.83	4.00	7.50
75%						
1. Surface	3.45	1.03	12.50	8.66	3.55	7.76
2. Drip	3.36	0.90	11.33	8.66	3.01	8.18
F.Test	N.S	*	*	*	*	N.S

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الاستخدام الأمثل لكميات مياه الري و نظم الري على صنفين من الشمام تحت ظروف منطقة الأحساء بالمملكة العربية السعودية

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أجريت دراسات لتحديد الكميات المثلى و نظم الري المفضلة على صنفين من الشمام ، هما (1)- الصنف الامريكي (اناناس) و (2)- الصنف الصيني . و ذلك باستخدام كميتين من مياه الري (100% (976ملم) و 75% (710 ملم) من السعة الحقلية) و طريقتين هما الري (السطحي) بالغمر و الري بالتنقيط . و ذلك بمحطة التدريب و الأبحاث الزراعية و البيطرية التابعة لجامعة الملك فيصل خلال موسمين متتاليين (1999-2000) .

وقد أوضحت النتائج أن استخدام الري السطحي أعطى أعلى قيمة في كل من طول النبات ـ نسبة الوزن (الجاف / الطازج) للنبات ـ متوسط وزن الثمرة ـ طول الثمرة ـ قطر الثمرة ـ المحصول الكلي ـ المواد الصلبة الكلية . و توجد فروق قليلة في المحصول لصالح الري بالغمر. أما بالنسبة لكميات مياه الري فتجد أن المعاملة (100%) قد أعطت زيادة قليلة في المحصول بالمقارنة بالمعاملة (75%) من السعة الحقلية .

وأشارت النتائج إلى أن استخدام كمية المياه بمعدل 100 % من السعة الحقلية قد أعطت أفضل النتائج في كل من الصفات الخضرية والثمرية للشمام بالمقارنة بالمعاملة 75 % من السعة الحقلية ، تحت الظروف الجافة والحرارة المرتفعة في منطقة الأحساء .

أما بالنسبة لتقييم الأصناف نجد ان الصنف الأمريكي (أناناس) قد أعطى أفضل النتائج في كل من الصفات الخضرية والثمرية بالمقارنة بالصنف الصيني . كما أشارت نتائج العلاقة بين كمية المياه و الأصناف إلى أن الصنف الصيني مع 100 % من السعة الحقلية قد أعطى أفضل النتائج بالنسبة للصفات الخضرية بينما أعطى الصنف الأمريكي (أناناس) مع كمية الري 100% في المحصول الكلي . كما دلت نتائج العلاقة بين الأصناف و نظم الري المختلفة إلى أن الصنف الصيني مع الري السطحي قد أعطى أفضل النتائج في كل من طول النبات ونسبة الوزن (الجاف / الطازج) و عدد الفروع على النبات و المساحة الورقية و عدد أوراق النبات و عدد الثمار للنبات و ارتفاع الثمرة والمحصول الكلي . بينما أعطى الصنف الأمريكي مع الري السطحي أفضل النتائج بالنسبة لوزن الثمرة وقطرها في متوسط الموسمين . في حين أعطى الصنف الأمريكي مع الري بالتنقيط أعلى قيمة في المواد الصلبة .

أشارت النتائج أيضا إلى أن استخدام كمية المياه بنسبة 100 % من السعة الحقلية في نظام الري السطحي أعطت أعلى قيمة في النمو الخضري والثمري للشمام ، فيما عدا المواد الصلبة التي أعطت أفضل النتائج عند استخدام الري بالتنقيط . وأخيرا يمكن القول بان الري السطحي مع 100 % من السعة الحقلية أعطى زيادة قليلة في المحصول وبعض الصفات الخضرية بالمقارنة مع الري بالتنقيط بكمية مياه 75 % من السعة الحقلية في كلا الصنفين . ونظرا للفروق البسيطة بين محصول الشمام نتيجة معاملات الري فأنه يفضل استخدام نظام الري بالتنقيط مع كميات مياه 75 % من السعة الحقلية وذلك بغرض ترشيد وتقليل كميات المياه المستخدمة في الزراعة.