Effect of cultivars and irrigation periods on some growth and yield indicators for watermelon

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ABSTRACT

The experiment was conducted in a special field in Al-Radwaniya region, southwest of Baghdad, for the season of 2016 to study the effect of two cultivars of watermelon (King and Charleston), which it is symbolized by (V1, V2), respectively, and irrigation period (5, 10 and 15 days), which it is symbolized by (W1, W2, W3), respectively, in some vegetative growth and yield indicators. The seeds were cultivated on 12 March 2016 and the soil addition (N, P_2O_5, and K_2O) were used with a ratio of (120: 160: 100 kg.ha^{-1}). The area of experimental unit amounted to (12.5 m^2) (2.5 m length x 5 m width). The Randomized Complete Block Design (RCBD) were applied in three replicates and the amount of water was calculated for each of the treatments (5, 10, 15 days) using the water requirements for the crop which amounted to (600 mm) during the season. The results showed that King cultivar was excelled in all vegetative and yield traits, the irrigation period (5 days) gave a significant increase to the same traits of the study. As for the interaction treatment between King cultivar and the irrigation period (5 days) (V1W1) gave a significant increase in the traits of the study, where gave the highest value for the plant length (3.79 m), the number of main branches (6.70 branches.plant^{-1}), the number of leaves (776.0 leaves.plant^{-1}), the dry weight of the total vegetative (416.0 g.plant^{-1}), the number of fruits (2.25 fruit.plant^{-1}), the average weight of the fruit (5.36 kg.fruit^{-1}), Plant yield (12.07 kg.plant^{-1}), and the total yield (96.53 tons.ha^{-1}).

تأثير الصنف ومدد الري في بعض مؤشرات نمو وحاصل الرقي

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المستخلص

نفذت التجربة في حقل خاص في منطقة الرضوانية جنوب غرب بغداد للموسم 2016 لدراسة تأثير صنفي الرقي King و Charleston (V1 و V2 بالتتابع) ومدة الري ، الري بعد 5 و 10 و15 يوماً (W1 و W2 وW3 بالتتابع) في بعض مؤشرات النمو الخضري والحاصل .زرعت البذور في 12 اذار 2016 واستعملت الاضافة الارضية N و P2O5 و K2O بنسبة 120 :160 :100 كغم .هكتار $^{-1}$ ومساحة الوحدة التجريبية 12.5 م^2 (2.5 م طول X 5 م عرض) تم تطبيق القطاعات العشوائية الكاملة المعشاة (RCBD) بثلاث مكررات وتم احتساب كمياة الماء لكل من معاملات (5 و10 و15 يوم) بأستعمال الاحتياجات المائية للمحصول 600 ملم خلال الموسم ز اظهرت النتائج تفوق الصنف King معنويا في جميع مؤشرات النمو الخضري والحاصل ومدة الري 5 ايام اعطت زيادة معنوية لنفس مؤشرات الدراسة ا معاملة التداخل بين الصنف ومدة الري 5 ايام اعطت زيادة معنوية في مؤشرات الدراسة اذ اعطت اعلى قيمة لطول النبات 3.79 م وعدد الافرع الرئيسة 6.70 فرع.نبات $^{-1}$ وعدد الاوراق 776.0 ورقة .نبات $^{-1}$ والوزن الجاف للمجموع الخضري 416.0 غم .نبات$^{-1}$ وعدد الثمار 2.25 ثمرة .نبات$^{-1}$ ومعدل وزن الثمرة 5.36 كغم . ثمرة$^{-1}$ وحاصل النبات 12.07 كغم.نبات$^{-1}$ والحاصل الكلي 96.53 طن.هكتار$^{-1}$.

INTRODUCTION

Watermelon (Citrullus lanatus) is considered a Vegetable Crops of Cucurbitaceae family which is important in economic and food terms. Its fruit that contains carbohydrates, especially sugars, which have a great effect on the quality of fruits, as well as fiber and mineral salts such as calcium and iron. It also contains the pigment

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of Lycopene and carotene (Matlub, 1998). The cultivation of watermelon has spread since ancient times and the continent of Africa is considered the home of its origin, where it was found in a wild form (Ware and McCollum, 1968). Watermelon is cultivated in tropical and subtropical regions as well as large areas of the world. It can be cultivated in drained soils (clay and sandy soils), The environment in semi-arid areas with providing the irrigation water is considered the ideal environment for production (Halilu, 2014). Environmental stresses are considered the first cause of loss of crops worldwide and reduce production by up to 50%. Drought stress is one of the abiotic stresses, which results from the low availability of irrigation water in the plant environment, causing many physiological effects that lead to scarcity (Sinhababu and Rup Kumar, 2003). Watermelon requires 600 mm of water, which is not a small ratio, which indicates to the plant need to sufficient quantities of irrigation water. it cultivates in Iraq in the spring and the growth stages continue until the summer, so requires the availability of water irrigation regularly. The statistics of the last decade indicate the decrease in area and the total production for the watermelon crop. This deterioration is attributed to many reasons, including water scarcity, soil salinization, a decrease of arable land due to desertification, and the spread of pathogens in Iraqi soils (Al-Mashhadani 2014). Genetic variability and diverse genetic resources are considered to be the bases for acquiring genotypes that are resistant to environmental stresses. These sources include the adaptive and cultivated local cultivar for the cultivation area, as well as other agricultural processes that help or reduce the damage of these environmental stresses such as scheduling irrigation water, adding organic fertilizer and covering soil. (Kusvuran et al., 2013; Ibrahim, 2012; Al-Juboori 2015). The quantity of added water during growth stages varies depending on the type of cultivated crop, the stage of growth and the environmental conditions. Irrigation scheduling is considered one of the water management strategies which aims at rationing the amount of irrigation water to be added without any effect in the yield and without stress events on the plant. Water Use Efficiency (WUE) also reflects the relationship of the yield in the unit area to the amount of used water (Hillel, 1990; Marais et al., 1998; AL-Mharib, 2014). The plants of watermelon are affected by the scarcity of irrigation water. The most sensitive stages for water shortage are the fruit set stage and the developing of the watermelon fruit in the filling stage (Erdem, Yuksel, 2003; Wakindiki and Kirambia, 2011). Leskovar et al., (2004) indicated to decrease of the watermelon yield with a ratio of (34%) at irrigation yield of 75ETc, meaning Maintain the amount of irrigation water at 25%. Fabeiro, (2002) found that the lack of irrigation water led to a decrease in the size of fruits and the lack of yield when they study the two cultivars of (Piel de sapo and Sancho). This study aims to study the effect of irrigation periods on the growth and yield of two cultivars of cultivated watermelon in Iraq.

MATERIALS AND METHODS

The research was conducted in a special field in Al-Radwaniya region, southwest of Baghdad, for the season of 2016, where two cultivars are (Charleston and king), which are symbolized by (V1 and V2), respectively. The seeds of the two cultivars were cultivated directly in the field on 12/3/2016 after plowing and smoothing and adding animal manure. Cultivation was conducted in the terraces method with a length of 2.5 m and a width of 5 m, with the rate of ten plants for the experimental unit, which cultivated on both sides of the terrace and the distance between the plant and another is 50 cm and the area of the experimental unit amounted to (12.5 m^2). The experiment was conducted on the basis of comparison between the two cultivars in terms of the study of the vegetative growth indicators and the difference with the different irrigation periods where water was irrigated once every 5, 10 and 15 days, which

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symbolized by (W1, W2, W3), respectively. The soil addition (N, P_2O_5, and K_2O) were used with a ratio of (120: 160: 100 $kg.ha^{-1}$) (Ali, 2012). The Randomized Complete Block Design (RCBD) was applied, with three replicates. The results were analyzed using the Genstat program and the averages were compared using the least significant difference (L.S.D) at the probability level of 5% (Al-Rawi and Khalaf Allah, 2000).

Study indicators

First: Indicators of vegetative growth

Five plants were selected from the middle of the experimental unit to measure the traits of the vegetative growth.

1- **Length of the plant (m):** It was measured at the end of the growing season from the stem contact area with soil to the top of the Apical meristem for the lengthier branch using the measuring tape.

2- **The number of branches (branch.plant^{-1}):** The number of sub-branches on the main stem was calculated at the end of the growing season.

3- **The number of leaves (leaf.plant^{-1}):** It was calculated for the plant after plant extraction, including fallen leaves.

4- **The dry weight of the total vegetative (g.plant^{-1}):** It was calculated at the end of the experiment by cutting the plants at the level of the soil surface and drying it in the electric oven at a temperature of (70 ºC) until the weight stability.

Second: indicators of the yield

1- **The number of fruits (fruit.plant^{-1}):** It was calculated in the experimental unit from the beginning of the harvest until the last harvest and divided on the number of plants for the experimental unit by the following equation:

$$\text{the number of fruits (fruit.plant}^{-1}\text{)} = \frac{\text{Total number of fruits in the experimental unit}}{\text{number of plants in the experimental unit}}$$

2- **Fruit weight (kg.fruit^{-1}):** It was calculated based on the following equation:

$$\text{Fruit weight (kg.fruit}^{-1}\text{)} = \frac{\text{The yield of the experimental unit (kg)}}{\text{number of fruits for the experimental unit}}$$

3- **Plant yield (kg.plant^{-1}):** It was calculated according to the following equation:

$$\text{Plant yield (kg.plant}^{-1}\text{)} = \frac{\text{The yield of the experimental unit (kg)}}{\text{number of plants for the experimental unit}}$$

4- **Total yield (tons.ha^{-1}):** It was calculated based on the yield of all the plants of the experimental unit from the beginning of the harvest until the last harvest.

RESULTS AND DISCUSSION

1- **Effect of the cultivar and irrigation period in the indicators of vegetative growth**

Table (1) shows that King cultivar (V1) was excelled in all studied vegetative growth indicators by giving it the highest length of the plant, the number of main branches, the number of leaves and the dry weight for the vegetative growth amounted to (2.95 m, 5.37 branches. plants^{-1}, 614.3 leaves.plant^{-1}, 314.7 g), respectively compared to Charleston cultivar (V2). The same table indicates that the irrigation period W1 was significantly excelled by giving it the highest average of plant length amounted to (3.04 m) while decreased in the irrigation period 15 days, which amounted to (1.89 m). The effect of the irrigation period W3 was reflected on all growth indicators to give the lowest length of the plant, The number of the main branches and the number of leaves and the dry weight for the total vegetative compared to the irrigation period 5 days to give the highest average of plant length, The number of the main branches and the number of leaves and the dry weight for the total vegetative amounted to

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(3.04 m, 6.15 branches.plant^{-1},603.5 leaves.plant^{-1}, 351.5 g). Table (1) shows the superiority of the V1W1 treatment in all vegetative growth indicators compared with the V2W3 treatment, in which all the studied indicators decreased.

Table 1: Effect of the cultivar and irrigation period in the indicators of vegetative growth.

Treatments		**Plant length (m)**	**The number of the main branches (branches.plant^{-1})**	**The number of leaves (leaves.plant^{-1})**	**The dry weight for the total vegetative (g)**
Cultivar V	V1	2.95	5.37	614.3	314.7
	V2	1.88	4.73	345.0	222.3
Irrigation period **W**	W1	3.04	6.15	603.5	351.5
	W2	2.32	4.95	469.0	277.5
	W3	1.89	4.05	366.5	176.5
V1	W1	3.79	6.70	776.0	416.0
	W2	2.82	5.20	586.0	323.0
	W3	2.24	4.20	481.0	205.0
V2	W1	2.29	5.60	431.0	287.0
	W2	1.81	4.70	352.0	232.0
	W3	1.53	3.90	252.0	148.0
L.S.D 0.05	V	0.070	0.162	5.59	5.80
	W	0.087	0.198	6.84	710
	V×W	0.122	0.280	9.68	10.05

2- Effect of the cultivar and irrigation period in the indicators of yield

Table (2) shows the king cultivar (V1) was significantly excelled by giving it the highest average for the number of fruits, fruit weight, plant yield and total yield (tons.ha^{-1}), which amounted to (1.69 fruit.plant^{-1}, 4.32 kg.fruit^{-1}, 7.74 kg.plant^{-1}, 61.91 tons.ha^{-1}), respectively compared to Charleston cultivar (V2) while the irrigation period W1 was significantly excelled in the number of fruits per plant, the weight of fruit, plant yield and the total yield (tons.ha^{-1}) amounted to (2.00 fruit.plant^{-1}, 4.10 kg.fruit^{-1}, 8.52 kg.plant^{-1}, 68.16 tons.ha^{-1}), respectively compared to the irrigation period W3, in which the number of fruits per plant, the weight of fruit, plant yield and the total yield decreased to (1.10 fruit.plant^{-1}, 2.34 kg.fruit^{-1}, 2.62 kg.plant^{-1}, 20.95 tons.ha^{-1}). Table (2) shows the effect of the interaction between the cultivar and the irrigation period in the indicators of the yield, where the V1W1 treatment was significantly excelled in all indicators of the yield by giving it the highest number of fruits per plant, the weight of fruit, plant yield and the total yield amounted to (2.25 fruit.plant^{-1}, 5.36 kg.fruit^{-1}, 14.07 kg.plant^{-1}, 96.53 tons.ha^{-1}), respectively.

The results of Tables (1, 2) indicate that King cultivar was excelled in Charleston in all studied vegetative growth indicators due to the genetic variability between the two cultivars, where each cultivar carries different genetic information in its genotype. As for irrigation periods, the difference between the irrigation period (5, 10 and 15 days) indicates that the higher level of soil moisture (low water stress) represented by W1 has led to improve the vegetative growth through increasing the photosynthesis, increasing cell division and its extinction, increasing the number of flowers, improving the percentage of fruit set and increasing the number of fruits and their weight and increasing the plant yield and the total yield. On the contrary, the reduction of moisture

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content of the soil (increased wet stress) represented by (W2 and W3) caused the inhibition of photosynthesis due to partial or total closure of the stoma and low exchange of carbon dioxide, As well as lack of nutrient elements availability in the soil and absorption by the plant (AL-Mharib, 2014; Leskovar et al., 2004).

Table 2: Effect of the cultivar and irrigation period in the indicators of yield.

Treatments		**Number of fruits (fruit.plant^{-1})**	**Weight of fruit (kg.fruit^{-1})**	**Plant yield (kg.plant^{-1})**	**Total yield (tons.ha^{-1})**
Cultivar V	V1	1.69	4.32	7.74	61.91
	V2	1.36	2.19	3.13	25.08
Irrigation period **W**	W1	2.00	4.10	8.52	68.16
	W2	1.49	3.33	5.17	41.37
	W3	1.10	2.34	2.62	20.95
V1	W1	2.25	5.36	12.07	96.53
	W2	1.68	4.48	7.54	60.29
	W3	1.15	3.13	3.61	28.91
V2	W1	1.75	2.84	4.97	39.7.9
	W2	1.29	2.17	2.81	22.45
	W3	1.04	1.56	1.62	12.99
L.S.D 0.05	V	0.042	0.025	4.973	1.710
	W	0.051	0.030	2.807	2.095
	V×W	0.072	0.043	1.623	2.963

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