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RESPONSE OF TWO COTTON CULTIVARS (*GOSSYPIUM HIRSUTUM* L.) TO SPRAYING WITH PROLINE ACID UNDER WATER STRESS CONDITION

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Abstract

A field experiment was conducted in the Jibela region, Al-Mussaib project area, Babylon province, for the season (2019), The factorial experiment was conducted according to the randomized complete block design (RCBD) and three replicates, with the aim of studying the effect of foliar spray of proline acid in concentrations (0, 50 and 100) $mg.L^{-1}$ with irrigation period (7, 14 and 21) days on the growth and yield of cotton for the cultivars (Assyria and Lashata). The results of the experiment are summarized as follows: The effect of proline acid significantly on most studied traits. The concentration 100 $mg.L^{-1}$ achieved the highest average growth traits yield, leaf content of chlorophyll (43.55) SPAD, seed cotton yield (81.66) $g.plant^{-1}$, fiber yield (29.73) $g.plant^{-1}$. and the number of days from cultivated until the first flower opens (68.10) days. The effect of foliar spray cultivars significantly in most studied traits. The cultivar Assyria excelled in most of the average growth traits, the total number of bolls (20.63) $boll.plant^{-1}$ and the bolls weight (4.18) $boll.plant^{-1}$and the seed cotton yield (76.78) $g.plant^{-1}$, Fiber yield (27.81) $g.plant^{-1}$. The irrigation period affected significantly in the most studied traits, where the irrigation period every 7 days excelled significantly in the number of vegetative branches (3.39) $branch.plant^{-1}$ and the leaf content of chlorophyll (40.87) SPAD and plant height (90.04) cm and Number of days from cultivated until the first flower opens(14.13) $Plant^{-1}$ and the total number of bolls (22.27) and bolls weight (4.46) $g.boll^{-1}$and the seed cotton yield (79.68) g^{-1}, and fiber yield (29.21) $g.plant^{-1}$. Effect of the interaction between proline acid and cultivars significantly. The concentration of proline acid 100 $mg.L^{-1}$ with Assyria cultivars was given the highest average in plant height (91.26) cm, leaf content of chlorophyll (43.65) SPAD, bolls weight (4.55) $g.boll^{-1}$, and the total number of bolls (22.02)$boll.plant^{-1}$, the seed cotton yield (81.12) $g.plant^{-1}$and fiber yield (30.63) $g.plant^{-1}$.

***Keywords*:** cultivars, proline, water stress, cotton yield

Introduction

The cotton crop (*Gossypium hirsutum*), which belongs to Malvaceae family is one of the most important global economic crops, Which is cultivated for the purpose of producing fibers and extracting oil from its seeds and still occupies the privileged position among the industrial crops, as it is a raw material in many industries such as the textile industry, as its fibers constitute 35% of the weight of the cast cotton, and edible oil is extracted from it, Where the cotton seeds contain approximately (18-26%) oil from the seeds weight (Al-Qaisi and Shatti, 2010), the gain is used after extracting the oil in the animal feed because it contains a high protein ratio ranging between (32-36%),As for the lint produced after shaving the seed mechanically, it is used in some military industries (Hammood, 2003), that the cultivated area in Iraq of the cotton crop reached (33) hectares in 2018 and the production average amounted to (70,075 $kg.ha^{-1}$) (Central Statistical Organization, 2018), Productivity per unit area remains low in Iraq compared to global production (Arab Organization for Agricultural Development, 2013), and Iraq ranks 47 in the global ranking for 2011) as an average productivity (Unctad, 2012). The arid and semi-arid regions depend on the irrigation method in agriculture, where they constitute (13%) of all lands in the world, and that the irrigation methods are linked to the existing conditions that cause drought (Ateawy *et al.*, 1990). The water needs of the cotton plant are affected by many factors, including temperature, humidity, wind movement, amount of water available in the soil, and relative humidity in the atmosphere (Soomro *et al.*, 2001), And the lack of irrigation water is one of the determining factors in the growth and production of the cotton crop, and one of the methods used to control the scarcity of irrigation water is to follow modern advanced scientific techniques through the use of some growth regulators and nutrients that are easy for plants to absorb by the vegetative parts, Therefore, many research has emerged to reduce water stress and its impact on plants, such as spraying vegetative parts of the plant with proline, salicylic acid and others (Sarkis *et al.*, 2012).

The research aims to know:

1- Determine the best cultivars that give the best traits for vegetative and Fruit growth.

2- Determine the best concentration of proline acid, which gives the best traits for growth and good yield.

3- Determine the best irrigation period that gives the best traits for the vegetative and Fruit growth of the crop.

4- Determine the best interaction between the factors that give the best yield.

Materials and Methods

A field experiment was conducted in the Jibela region, Al- Mussaib project area, Babylon province, Which is about 40 km from the center of Babylon province, for the season (2019), to study the effect of foliar spray for proline acid and determine the best cultivars and the best concentration for it and the best irrigation period that gives the best traits for the growth of the cotton crop, and a factorial experiment was conducted according to the randomized complete block design (RCBD) and three replicates, The first factor is two types of cotton: (Assyria and Lashata), which symbolized by (V2, V1), and the second factor is spraying proline with three concentrations (0, 50, 100) $mg.L^{-1}$ and which symbolized by

(P) and three spraying between one spray and another was 20 days and the third factor three irrigation periods (7, 14, 21) days between one irrigation to another, and which symbolized by (D1, D2 and D3) in succession, and the total number of experimental units was 54 experimental units. The experiment land was tillage by a moldboard plow. Then the smoothing, leveling and splitting into furrows were conducted, and the dimensions of the experimental unit were (4 x 4) m^2 with a distance of 1 m between each experimental unit and another, as well as leaving 2.5 m between the sectors for the purpose of controlling the movement of lateral water between the experimental units during irrigation. Each experimental unit included 4 pits, the distance from one to the other is 0.75 m, and the distance between furrows to another on the same pits is 0.40 m. Samples were taken from the soil randomly from the field, then transferred to the laboratory and estimated some physical and chemical traits (Table 1). Cotton seed (Assyria and Lashata) was used in the experiment, the first is a local cultivar and the second is a Spanish cultivars entered by the National Program for Cotton Cultivation in Iraq (Ministry of Agriculture, (2004 registered and approved in Iraq in 2001), which are distinct cultivars in terms of growth traits, yield components, early maturity and specifications Lint (Saleh and Khalil, 2012) The seeds were cultivated in the experiment field dated 10/4/2019 at a average of 3-4 seed in each pit (Al-Tayyar, 1992). The failed pod were cultivated with seeds from the same cultivars, on 4/4/2019 then the plants Thinning to one plant three weeks after the date of cultivated, were the plant density became 53333.33. ha (Al-Qaisi, 2010). Nitrogen fertilizer was added in the amount of 220 $kg.ha^{-1}$ using urea (46%) N as a source of fertilizer in two equal batches, the first immediately after the thinning, and the second after the lapse of a month after adding the first batch, During the period of crop growth, all necessary field procedures and works were conducted to protect plants from weeds, diseases and insects, as broad and thin leaved weed were by spraying with imacate (dichloride brace). The *Earias insulana* spinal worm was controlled with the CONFIDOR pesticide. The yield of each experimental unit was collected separately for the cotton/Kadhimiya fabrics as well as the lint traits.

The following traits were studied

First / growth traits :

The traits of vegetative and yield growth and its components were measured for ten plants randomly taken from each experimental unit.

1- Number of days from cultivated until the first flower opens. (day)

2- The plant height (cm): measured from the soil surface to the highest point in the main stem.

3- Number of vegetative branches: These are the branches that grow at the base of the stem from the axillary buds of the main stem.

4- The leaf content of chlorophyll: The measurements were taken before the first harvesting with a Minolta SPAD502 device which measures the degree of leaf greening, as I took three readings from each leaf, by placing the plant leaf between the jaws of the device without cutting the leaf from the plant where the average of five leaves was taken Randomized from all ten plants (Hussain, 2007).

Table 1 : Physical and chemical traits for the soil experiment

Traits	Values
Sand	34.8 %
Silt	42.6 %
Clay	22.6 %
Soil texture	silty loam
EC	4.86 (ds.m)
pH	7.40
NO_3	(78.7 ppm)
P	(ppm) 20
Organic matter (O.M.)	1.5 %

Results and Discussion

Number of days from cultivated until the first flower opens (day)

The results in Table (2) indicate that treatment B3 concentration (100 $mg.L^{-1}$) recorded the highest average of this trait amounted of (68.10) days compared to the control treatment without spraying Proline B1 recorded the lowest average amounted of (62.28) days. Perhaps the reason for this is that proline acid has a phenolic nature as it contributes to regulating physiological processes including flowering induction (Popova *et al.*, 1997). It is also believed that the proline acid influencing the flowering process results from the role it plays in stimulating genes involved in flowering regulation (Cleland and Ajami, 1974) and has discovered its first physiological role in the tobacco plant by stimulating the flowering process (Eberhard *et al.*, 1989 and Despair, 2004). In this regard, Al-Qaisi and Al-Montafaji (2011) found that the duration of flowering days decreased significantly when spraying Mung bean with proline acid. From table (2), it was found that there were significant differences between the cultivars, where the first cultivar (Assyria) gave the highest average of the trait amounted to (66.58) days compared to the second cultivar (Lashata), which recorded the lowest average of the trait amounted to (65.70) days. Increasing the concentration of sugars in the vegetative group of plants and their transfer to flower bud encourages flowering (Howard, *et al.*, 2001). In this area, Hussein (2010) found on saffron, Halfi and zabidi (2015) plants on the pea plant the effect of proline on the number of flowering days. Table (2) also shows the existence of significant differences in the average number of days the first flower opens due to the effect of different irrigation periods, where the irrigation period was recorded every 7 days with the highest average amounted to (68.02) days compared to the irrigation treatment every (21 days) that gave the lowest average for the trait It reached 63.68 days. Dry weather is suitable for flowering while high humidity in the air delays flowering and soil containing an appropriate amount of moisture excelled dry soil in terms of flowering for the plants growing in it and the lack of water affects the roots of plants, which affects flowering where the root is an important source of some growth hormones that affect flowering such as cytokines, and abundant irrigation leads to a delay in the date of the first flower (Shaker 1999). Also, the water discharge affects the date of the first flower and the flowering period in the cotton plant (Shafshaq and Al-Debabi, 2008). In this field, Sarheed (2016) indicated on the cotton plant that there were significant differences for water stress due to the number of flowering days. Table (2) shows a significant interaction between the concentration of proline acid and the irrigation period, where the irrigation

period was recorded every seven days with treatment B2 (50 mg.L^{-1}), the highest average amounted to (70.53 days) compared to the irrigation period every 21 days with treatment (B1 mg.L^{-1}), which recorded the lowest average of the amounted to (60.25 days). It is noted from Table (1) that there was a significant interaction between the concentration of proline acid and the cultivars, where the concentration of B3 (100 mg.L^{-1}) with the first cultivar (Assyria) was recorded, with the highest average amounted to (68.63) days, while the control treatment was recorded (B1 mg.L^{-1}) with the second cultivar (Lashata), the lowest average of amounted to(61.96) days. Table No. (2) shows the significant differences between the cultivars and the irrigation period, where the irrigation period was given every 7 days with the first cultivar (Assyria)the highest average of the trait reached (68.29) days compared to the irrigation period every 21 days and the second cultivar (Lashata), which recorded the lowest average for the traits , it reached (61.81) days. Also, Table (1) indicated that there was a highly significant triple interaction between the studied factors, as the irrigation period achieved every 7 days with treatment B2 (50 mg.L^{-1}) for the second cultivar (Lashata), the highest rate of the trait reached (70.65) days, while the duration Irrigation every 21 days with treatment B1 (mg.L^{-1}) for the second cultivar (Lashata). The lowest average amounted to 57.57 days.

Table 2 : Effect of Proline Acid Levels, Irrigation period, cultivars and interaction between them on the average Number of days from cultivated until the first flower opens (day)

Interaction	**Irrigation period(day)**			**Proline (mg.L^{-1}) B**	**Cultivars**
B*V	**D3**	**D2**	**D1**		V
62.60	62.93	60.91	63.95	B1	V1
68.51	67.08	68.02	70.42	B2	
68.63	66.66	68.74	70.49	B3	
61.96	57.57	64.91	63.40	B1	V2
67.55	63.61	68.41	70.65	B2	
67.57	64.26	69.24	69.22	B3	
0.80	1.38			L.S.D $_{0.05}$	
Average of Proline	D3	D2	D1	D*V	
66.58	65.56	65.89	68.29	V1	
65.70	61.81	67.52	67.76	V2	
0.46	0.80			L.S.D $_{0.05}$	
Average of **Irrigation period**	D3	D2	D1	D*B	
62.28	60.25	62.91	63.68	B1	
68.03	65.34	68.22	70.53	B2	
68.10	65.46	68.99	69.85	B3	
0.57	0.98			L.S.D $_{0.05}$	
	D3	D2	D1	**Average of Irrigation period**	
	63.68	66.71	68.02		
	0.57			L.S.D $_{0.05}$	

Plant height (cm)

Table (3) indicates that treatment B3 has a concentration of 100 mg.L^{-1}recorded the highest average amounted to 90.20 cm compared to the control treatment without spraying proline acid B1 that recorded the lowest average amounted to 78.56 cm. Proline acid has an active role in cell division and cellular elongation of plant tissue cells, meaning that the cell is painful, in which the division may occur, giving many new cells that grow in size and thus cause an increase in stem elongation (Al-Shahat, 2000) It also has a role in promoting and protecting the plant's root system, increasing, elongating, dividing and expanding cells, which contributes to forming a root system with the activity that can deliver plant nutrients, resulting in an increase in plant height (Troshima, 2004). Spraying the vegetative parts with proline acid resulted in the expansion and elongation of the plant cells, which caused an increase in the plant height (Wainland and Taylor, 1965). These results agree with Abdel Wahab and Al-Habiti (2017), (Al-Rawi *et al.,* 2014), Ali and Mahmoud (2013), Al-Montafaji (2011), Amin *et al.* (2008), Khan et al (2003), Shakirova *et al.* (2003) and Zhou *et al.* (1999). They indicated that proline acid affected plant height. Significant differences appeared among the cultivars in Table (2), as the first cultivar (Assyria) gave the highest average amounted to 87.16 cm compared to the second cultivar (Lashata), which recorded the lowest average amounted to 85.39 cm. Table (3) also shows the presence of significant differences in the average plant height due to the effect of different irrigation periods, where the irrigation period was recorded every 7 days, the highest average amounted to 90.04 cm compared to the irrigation period every 21 days, which gave the lowest average amounted to 81.37 cm. The vegetative growth stage is an effective stage for the growth, expansion and division of cells that are affected by water stress, that water stress works to inhibit the action of Auxin, which causes a reduction in plant height (Issa, 1990). As this result agreed with Sarheed (2016), Hamoda et al (2013), Onder et al (2009) and Attia *et al*. (2008), who indicated that there were significant differences for the plant height . From Table (3) indicated that there is a significant interaction between the concentration of proline acid and the cultivars, where the concentration of B3 100 mg.L^{-1} with the first cultivar (Assyria), recorded the highest average amounted to 91.26 cm, while the control treatment B1 mg.L^{-1} with the second cultivar (Lashata) recorded the lowest average amounted to 77.92 cm. Table (3) shows that there were

highly significant differences between the cultivar and the irrigation period, where the irrigation period was given every 7 days with the first cultivar (Assyria) the highest average of the trait was 90.57 cm compared to the irrigation period every 21 days and the second cultivar(Lashata), which was recorded the lowest average amounted to 77.62 cm. It is noted from Table (3) that there is a significant interaction between the proline concentration and the irrigation periods, where the irrigation period every 7 days with treatment B2 50 mg.L^{-1} was recorded the highest average of the traits amounted to 95.06 cm compared to the irrigation period every 21 days and treatment B1 mg.L^{-1} which recorded the lowest average amounted to 74.49 cm. Table(3) showed the presence of a triple significant interaction between the studied factors, as the irrigation period every 7 days with treatment 50 B2 mg. Liters^{-1} with the second cultivar (Lashata) the highest average of the trait reached 95.29 cm, while the irrigation period every 21 A day with treatment B1 mg.L^{-1} for the second cultivar (Lashata)achieved the lowest average amounted to 69.14 cm,

Table 3 : Effect of Proline Acid Levels, Irrigation period, cultivars and interaction between them on the average plant height (cm)

Interaction	**Irrigation period(day)**			**Proline (mg.L^{-1}) B**	**Cultivars** V
B*V	**D3**	**D2**	**D1**		
79.19	79.85	75.82	81.90	B1	V1
91.02	88.17	90.05	94.83	B2	
91.26	87.31	91.48	94.98	B3	
77.92	69.14	83.83	80.81	B1	V2
89.11	81.21	90.82	95.29	B2	
89.14	82.52	92.48	92.43	B3	
2.77	1.38			L.S.D $_{0.05}$	
Average of Proline	D3	D2	D1	D*V	
87.16	85.11	85.78	90.57	V1	
85.39	77.62	89.04	89.51	V2	
0.92	1.60			L.S.D $_{0.05}$	
Average of Irrigation period	D3	D2	D1	D*B	
78.56	74.49	79.82	81.35	B1	
90.06	84.69	90.43	95.06	B2	
90.20	84.91	91.98	93.71	B3	
1.13	1.96			L.S.D $_{0.05}$	
	D3	D2	D1	**Average of Irrigation period**	
	81.37	87.41	90.04		
	1.13			L.S.D $_{0.05}$	

Number of vegetative branches (plant.branch^{-1})

Table (4) indicates that the treatment B3 concentration (100 mg.L^{-1}) recorded the highest average amounted to (2.99) plant branch^{-1}, while the control treatment without spraying proline acid B1 gave the lowest average of the trait amounted to (2.45) plant.branch^{-1}. The addition of proline acid resulted in an increase in the level of cell division in the apical meristem, which in turn contributed to an increase in the vegetative and root system and an increase in the weight of the dry matter (Sakhabutdinova *et al.*, 2003), The increase in the dry matter is a result of the increase in the formation of new branches for the root and vegetative groups (Popova *et al.*, 1997). Significant differences emerged between the cultivars in Table (4), as the first cultivar (Assyria) gave the highest average quality of the trait amounted to (3.16) plant.branch^{-1} Compared with the second cultivar (Lashata), which recorded the lowest average quality of the trait amounted to (2.87) plant.branch^{-1}, In this field, the results agreed with Shaker (1999), who concluded that the increase in the irrigation of the crop leads to and contributes to the increase in the number of vegetative branches and Sarheed (2016), and Khairallah, (2012), Siddiqui *et al*. (2007), Mahmoud (2004) and Honey (2003), who indicated that there were significant differences in the average number of vegetative branches when exposing plants to different irrigation period and that reducing the irrigation of cotton plants contributed to the decrease in the number of vegetative branches (Alishah and Ahmadikhah, 2009). As Table (4) shows the presence of significant interaction between the concentration of proline acid and the cultivars, as the concentration of B3 100 mg.L^{-1} with the first cultivar (Assyria) was recorded the highest average of the trait reached (2.99) plant.branch^{-1} while the treatment of B1 mg. L^{-1} With the second cultivar (Lashata)was recorded the lowest average of the trait was 2.51 plant.branch^{-1},where table (4) indicated that there were significant differences between the cultivars and the irrigation period, as the irrigation period was given every 7 days with the first cultivar(Assyria) the highest average amounted to (3.61) plant.branch^{-1}, compared to the irrigation period every 21 days and the second cultivar (Lashata) which recorded the lowest average amounted to (2.11) plant.branch^{-1}, It is noted from Table (4) that there is significant interaction between the concentration of proline acid and the irrigation period, where the irrigation period every 7 days and the B2 treatment 50 mg.L^{-1} was recorded the highest average of the trait reached (3.46) plant.branch^{-1}, compared to the irrigation period every 21 days and The treatment B2 mg.L^{-1} that recorded the lowest average amounted to (1.42) plant. branch^{-1}, Table (4) showed that there was a highly significant triple interaction between the studied factors, as the irrigation period every 7 days with treatment B2 50 mg.L^{-1} achieved for the second cultivar (lashahat) the highest average of the trait reached (3.27) plant.branch^{-1} while the irrigation period every 21 days with the treatment is B1 mg.L^{-1} for the second cultivar (Lashata)the lowest average amounted to (1.62) plant.branch $^{-1}$

Table 4 : Effect of Proline Acid Levels, Irrigation period, cultivars and interaction between them on the average Number of vegetative branches (plant.branch^{-1})

Interaction	Irrigation period(day)			Proline (mg.L^{-1}) B	Cultivars V
B*V	D3	D2	D1		
2.72	2.69	2.66	2.82	B1	V1
2.79	2.41	2.80	3.15	B2	
2.99	3.00	2.78	3.20	B3	
2.51	1.62	3.00	2.90	B1	V2
2.80	2.02	3.11	3.27	B2	
2.98	2.72	3.00	3.21	B3	
0.48	1.38			L.S.D $_{0.05}$	
Average of Proline	D3	D2	D1	D*V	
3.16	2.81	3.07	3.61	V1	
2.87	2.11	3.34	3.16	V2	
0.16	0.28			L.S.D $_{0.05}$	
Average of Irrigation period	D3	D2	D1	D*B	
2.45	1.42	2.65	3.28	B1	
2.79	2.21	2.71	3.46	B2	
2.99	2.77	2.77	3.42	B3	
0.20	0.34			L.S.D $_{0.05}$	
	D3	D2	D1	**Average of Irrigation period**	
	2.47	2.71	3.39		
	0.20			L.S.D $_{0.05}$	

Leaf content of Chlorophyll (SPAD)

Table (5) that the treatment B3 at a concentration (100 mg.L^{-1}) recorded the highest average amounted to (43.55) SPAD compared to the control treatment without spraying the proline acid B1 recorded the lowest average amounted to (35.23) SPAD. The reason is due to that proline acid preserves the plastids from demolition (which are caused by increased production of free radicals ROS) and raises the rates of antioxidants, which keep the plastids and pigments from decomposition due to environmental stress (joseph *et al.*, 2010), and that proline acid is considered an antioxidant and protection Photovoltaic regulates photosynthesis and growth (Beltagi, 2008), Also, proline acid has an important role in stimulating hormones to form chlorophyll in the leaf and increase its content compared to the rest of the parts, and these hormones are cytokinin necessary for the emergence of chloroplast during the growth and development of the paper, as the increase in concentrations of proline acid resulted in an increase in concentrations of chlorophyll A , B and total chlorophyll (Kaydan *et al.*, 2006 and Despair, 2014). These results are consistent with EL-Sabagh *et al*. (2018), Jassim and Mohsen (2015), Al-Qaisi and Al-Janabi (2014), Shalaby et al (2013), Amgad *et al.* (2013), Jassim and Matar (2013), Rao *et al.* (2012), El-Tayab, 2005), Khodary (2004), Sakhabutdinova *et al.* (2003), who reached the effect of L-acid Rollin on the leaf content of chlorophyll. Also, there were significant differences between the cultivars in Table(5). The first cultivar (Assyria) gave the highest average of trait amounted to (39.59) SPAD compared to the second cultivar (Lashata), which recorded the lowest average amounted to (37.73) SPAD. Table (5) also shows the existence of significant differences in the effect of different irrigation periods, where the irrigation period every 7 days was recorded the highest average amounted to (40.87) SPAD compared to the irrigation period every 21 days that gave the lowest average amounted to (38.20) SPAD, Table (5) indicated that there was a significant interaction between the concentration of proline acid and the cultivars, where the concentration of B3 at concentration 100 mg.L^{-1} with the first class (Assyria) was recorded the highest average amounted to (43.65) SPAD, whereas the treatment of B1 mg.L^{-1} with the second cultivar (Lashata), the lowest average amounted to (34.59) SPAD. It is noted in Table (5) that there are highly significant differences between the cultivar and the irrigation period, where the irrigation period every 7 days with the first cultivar (Assyria) was given the highest average of the trait amounted to (42.01) SPAD compared to the irrigation period every 21 days and the second cultivar (Lashata) that was recorded The lowest average amounted to (35.65) SPAD. Also, it is noticed from Table (5) that there is a significant interaction between the concentration of proline acid and irrigation period, where the irrigation period every 7 days and the treatment B2 50 mg. Liters^{-1} was recorded the highest average amounted to (44.29) SPAD compared With irrigation period every 21 days and treatment B1 mg. Liter^{-1} that recorded the lowest amounted to (34.45) SPAD. Table (5) shows that there was a highly significant triple interaction between the studied factors, where the irrigation period every 7 days with treatment B2 50 mg.L^{-1} for the second cultivar (Lashata) achieved the highest average amounted to (45.40) SPAD, while the irrigation period every 21 Days with treatment B1 mg.L^{-1} for the second class (Lashata) achieved the lowest average amounted to (30.96)SPAD .

Table 5 : Effect of Proline Acid Levels, Irrigation period, cultivars and interaction between them on the average leaf content of Chlorophyll (SPAD)

Interaction	**Irrigation period(day)**			**Proline ($mg.L^{-1}$) B**	**cultivars V**
B*V	**D3**	**D2**	**D1**		
34.87	35.94	31.91	36.76	B1	V1
41.34	38.34	40.50	45.18	B2	
43.65	43.97	42.90	44.09	B3	
34.59	30.96	38.18	34.62	B1	V2
40.15	36.00	39.06	45.40	B2	
41.11	37.99	44.15	14.20	B3	
2.73	1.38			L.S.D $_{0.05}$	
Average of Proline	D3	D2	D1	D*V	
39.95	40.75	73.11	42.01	V1	
37.73	35.65	37.80	39.74	V2	
0.91	1.58			L.S.D $_{0.05}$	
Average of Irrigation period	D3	D2	D1	D*B	
35.23	34.45	35.55	35.69	B1	
40.75	37.17	40.78	44.29	B2	
43.55	42.98	44.02	43.65	B3	
1.12	1.93			L.S.D $_{0.05}$	
	D3	D2	D1	**Average of Irrigation period**	
	38.20	40.45	40.87		
	1.12			L.S.D $_{0.05}$	

Total number of bolls (boll.plant^{-1})

Table (6) indicates that the treatment B3 concentration (100 mg.L^{-1}) gave the highest average amounted to (22.35) boll.plant-1, while the control treatment without spraying the Proline acid B1 gave the lowest average amounted to (19.00) boll.plant^{-1}. The reason for this may explain that the increase in the number of fruit branches as a result of the external addition of proline acid has a positive effect on the increase in the Total number of bolls in the plant. In this field, Heitholt *et al.* (2001) found numerical differences in the Total number of bolls with increased concentrations of proline acid. There were also significant differences between the cultivars in Table (6), as the first cultivar(Assyria) gave the highest average amounted to (20.63) boll.plant^{-1}, compared to the second cultivar (Lashata), which recorded the lowest average amounted to (19.67) boll.plant^{-1}, Table (6) also showed the presence of significant differences in the average total number of bolls due to the effect of different irrigation periods, where the irrigation period every 7 days was recorded with the highest average amounted to (22.27) boll.plant^{-1} compared to the irrigation period every 21 days that gave the lowest average amounted to (19.53) boll.plant^{-1} .The reason for this is that the increased irrigation of the crop leads the plant to its vegetative growth, which causes an increase in flowering falls, which affects the proportion of the total bolls. The timing of the different irrigation periods has a significant impact on the intensity of the fall of the bolls before ripening. Also, increasing the water in the soil with a high percentage leads to the same result (Matar, 1985), and this result agreed with both Khairallah (2012) and Honey (2003), who indicated that the different irrigation times significantly affect the total number of the bolls for the plant.Table (6) indicates a significant interaction between the concentration of proline acid and the cultivars , as the concentration of B3 100 mg.L^{-1} with the first cultivar (Assyria) was recorded the highest average of the trait amounted to (22.02) boll.plant^{-1},while the treatment of B1 was recorded With the second cultivar (Lashata), the lowest average amounted to (17.71) boll.plant^{-1}, It is noted from Table (6) that there are significant differences between the cultivars and the irrigation periods, as the irrigation period every 7 days with the first cultivar (Assyria)is given amounted to (22.75) boll.plant^{-1}compared to the irrigation period every 21 days, and the second cultivar (Lashata), which recorded the lowest average amounted to (17.71) boll.plant^{-1}. Table (6) that there is a significant interaction between the proline acid concentration and the irrigation period, where the irrigation period every 7 days and the treatment was B250 mg.L^{-1} was recorded the highest average amounted to (23.70) boll.plant^{-1} compared to the irrigation period every 21 days and treatment B1 mg.L^{-1}, which recorded the lowest average amounted to (17.05) boll.plant^{-1}. Table (6) showed that there was a highly significant triple interaction between the studied factors, where the irrigation period every 7 days with treatment B2 50 mg.L^{-1} for the second category (Lashata) achieved the highest average amounted to (24.34) boll.plant^{-1} while it achieved an Irrigation period every 21 days with treatment B1 mg.L^{-1} for the second cultivar (Lashata)the lowest average amounted to 15.25 boll. plant^{-1}.

Table 6 : Effect of Proline Acid Levels, Irrigation period, cultivars and interaction between them on the average Total number of bolls (boll.plant^{-1})

Interaction	Irrigation period(day)			Proline (mg.L^{-1}) B	cultivars V
B*V	D3	D2	D1		
18.40	19.31	15.44	20.43	B1	V1
21.47	19.25	21.09	24.06	B2	
22.02	22.50	19.79	23.77	B3	
17.71	15.25	18.80	19.09	B1	V2
19.72	16.42	18.40	24.34	B2	
21.11	20.19	20.20	22.95	B3	
1.71	1.38			L.S.D $_{0.05}$	
Average of Proline	D3	D2	D1	D*V	
20.63	20.35	18.78	22.75	V1	
19.67	17.71	20.51	20.79	V2	
0.57	0.99			L.S.D $_{0.05}$	
Average of Irrigation period	D3	D2	D1	D*B	
19.00	17.05	19.19	20.76	B1	
20.59	17.83	20.25	23.70	B2	
22.35	21.71	22.00	23.36	B3	
0.70	1.21			L.S.D $_{0.05}$	
	D3	D2	D1	**Average of Irrigation period**	
	19.53	20.14	22.27		
	0.70			L.S.D $_{0.05}$	

Boll weight (g. boll $^{-1}$)

Table (7) indicates that the treatment B3 concentration (100 mg.L^{-1}) recorded the highest average of the trait was (4.40) g. boll^{-1} compared to the control treatment without spraying Proline acid B1 mg.L^{-1} recorded the lowest average of the trait was (3.93) g. boll^{-1}. The addition of proline acid results in an increase in the level of cell division in the apical meristem, which in turn contributed to an increase in the vegetative and root system, and an increase in the dry matter (Sakhabutdinova and others 2003), which results in an increase in boll weight. There were also significant differences between the cultivar in Table(7) The first cultivar (Assyria) gave the highest average of the trait amounted to (4.18) g. boll^{-1} compared to the second cultivar (Lashata), which recorded the lowest average amounted to (3.19) g. boll^{-1}, Table (7) also shows the presence of significant differences in the boll weight due to the effect of different irrigation periods, where the irrigation period every 7 days was recorded the highest average of this trait amounted to (4.46) g. boll^{-1} compared to the irrigation treatment every 21 days that gave the lowest average amounted to (3.82) g. boll^{-1}. As this result affects that the boll weight decreases negatively when increasing water stress, as the water stress causes closing the stomata and the wilting of the plant leaves reduces the average of photosynthesis, which leads to the small size of the boll. Also, the increase in irrigation water causes the plant to move to vegetative growth instead of fruiting growth (Khairallah, 2012). This result was agreed with Sarheed (2016), Mahmoud (2004), Matar (1985), Lee (2003) and Honey (2003), as they indicated that the average weight of the walnut in the cotton plant was affected by different irrigation times. Table (7) indicates a significant interaction between the concentration of proline acid and the cultivars, where it recorded the concentration of B3 100 mg.L^{-1} with the first cultivar (S118). The highest average of amounted to (4.55) g. boll^{-1}, while the treatment of B1 mg.L^{-1} With the second cultivar (SP886), the lowest average of this trait amounted to (3.93) g. boll^{-1}. It is noted in Table (7) that there are high significantly differences between the cultivar and the irrigation periods, where the irrigation period every 7 days with the first cultivar (Assyria) is given the highest average amounted to (4.82) g. boll^{-1} compared to the irrigation period every 21 days and the second cultivar (Lashata) which recorded the lowest average amounted to 2.62 g. boll^{-1}, It is also noted from Table (7) that there is a significant interaction between the proline acid concentration and the irrigation period, as the irrigation period every 7 days and the treatment B2 at concentration 50 mg.L^{-1} was recorded the highest average amounted to (5.20) g. boll^{-1} compared to the irrigation period every 21 days and the treatment B1 mg.L^{-1}, which recorded the lowest average f amounted to (3.03) g. boll^{-1}. Table (7) shows that where the triple interaction between the studied factors significantly excelled, Where the irrigation period every 7 days and the treatment B2 50 mg.L^{-1} the second cultivar (Lashata), achieved the highest average amounted to (5.62) g. boll^{-1}. The treatment 21 days and B1 mg.L^{-1} for the second cultivar (Lashata), which recorded the lowest average amounted to (2.94) g. boll^{-1}.

Table 7 : Effect of Proline Acid Levels, Irrigation period, cultivars and interaction between them on the average boll weight (g. boll^{-1})

Interaction	Irrigation period(day)			Proline (mg.L^{-1}) B	cultivars V
B*V	D3	D2	D1		
3.79	4.12	3.08	4.18	B1	V1
4.52	3.49	4.49	5.57	B2	
4.55	4.44	4.70	4.52	B3	
3.39	3.94	3.72	3.52	B1	V2
3.93	2.89	3.20	5.62	B2	
3.59	3.11	3.49	4.16	B3	
0.76	1.38			L.S.D $_{0.05}$	
Average of Proline	D3	D2	D1	D*V	
4.18	4.02	3.69	4.82	V1	
3.19	2.62	3.10	3.85	V2	
0.25	0.44			L.S.D $_{0.05}$	
Average of Irrigation period	D3	D2	D1	D*B	
3.93	3.03	3.90	4.85	B1	
4.23	3.16	40.33	5.20	B2	
4.40	4.28	4.60	4.34	B3	
0.31	0.54			L.S.D $_{0.05}$	
	D3	D2	D1	**Average of Irrigation period**	
	3.82	4.27	4.46		
	0.31			L.S.D $_{0.05}$	

Seed cotton yield (g.plant^{-1})

The seed cotton yield represents the final result of all physiological processes during the life cycle of the plant, which includes the manufacture of photosynthesis products and then the dry matter yield, which represents the seed cotton yield the economic and important part of it, as the needs of the plant for water are affected by many factors, including temperature, humidity and the quantities of water available in the soil (Shaker, 1999). The quality of The seed cotton yield product is one of the indicators of other traits such as the number of bolls in the plant, the boll weight and the increase in the fruit branches of the plant, with the availability of appropriate climatic factors such as increasing the amount of radiation falling on the lower leaves and increasing the root system, This is confirmed by the researchers Kerby and Adams, 1985 and Jenkins *et al.*, 1990). Table (8) indicates that the treatment B3 concentration (100 mg.L^{-1}) recorded the highest average amounted to (81.66) g.plant^{-1} compared to the control treatment compared to spraying Proline acid B1 mg.L^{-1} recorded the lowest average level (71.29) g.plant^{-1}. Significant differences emerged among the cultivar in Table (8). The first cultivar (Assyria) gave the highest average amounted to (76.78) g.plant^{-1} compared to the second cultivar (Lashata), which recorded the lowest average amounted to(74.00) g.plant^{-1}, Table (8) also showed the presence of significant differences in the average seed cotton yield due to the effect of different irrigation periods, as every 7 days the highest average reached (79.68) g.plant^{-1} compared to the irrigation treatment every 21 days that gave the lowest average of reached (73.91) g. Plant^{-1}. The reason for this is that increased soil moisture leads to increased vegetative growth and consequently leads to an increase in seed cotton yield (Al-Rawi, *et al.*, 2014, Yasser and Muhammad, 2013, and Matar, 1985). They concluded that different irrigation periods affect the seed cotton yield. Table No. (8) indicates the presence of significant interaction between the concentration of proline acid and the cultivars, as the concentration of B3 100 mg.L^{-1} with the first cultivars (Assyria) recorded the highest average amounted to (81.12) g.plant^{-1}, while the treatment of B1 mg.L^{-1} With the second cultivar (Lashata), the lowest average amounted to(70.45) g.plant^{-1}, Table(8) that there are highly significant differences between the cultivars and the irrigation periods, where the irrigation period every 7 days with the first cultivar(Assyria)is given the highest average of the trait amounted to(80.05) g.plant^{-1} compared to the irrigation period every 21 days and the second cultivar (Lashata) was gave the lowest average amounted to (72.27) g.plant^{-1}. It is also noted from Table (8) that there is a significant interaction between the concentration of proline acid and the irrigation period, where the irrigation period was recorded every 7 days and the treatment was B2 50 mg.L^{-1} the highest average amounted to (84.39) g.plant^{-1} compared to the irrigation period every 21 days and treatment B1 mg.L^{-1}, which recorded the lowest average amounted to (70.10) g.plant^{-1}. Table (8) showed that there was a highly significant triple interaction between the studied factors, as the irrigation period achieved every 7 days with the treatment B2 50 mg.L^{-1} for the second cultivar (Lashata). Irrigation every 21 days with B1 mg.L^{-1} for the second cultivar (Lashata)the lowest average amounted to (67.50) g.plant^{-1}.

Table 8 : Effect of Proline Acid Levels, Irrigation period, cultivars and interaction between them on the average seed cotton yield (g.plant^{-1})

Interaction	Irrigation period(day)			Proline (mg.L^{-1}) B	cultivars V
B*V	D3	D2	D1		
71.45	72.71	68.22	73.43	B1	V1
77.77	71.68	78.22	83.40	B2	
81.12	82.27	77.76	83.32	B3	
70.45	67.50	74.10	69.76	B1	V2
76.69	68.56	76.15	85.37	B2	
80.53	78.76	80.01	82.82	B3	
4.53	1.38			L.S.D $_{0.05}$	
Average of Proline	D3	D2	D1	D*V	
76.78	75.55	74.74	80.05	V1	
74.00	70.27	75.42	76.32	V2	
1.51	2.61			L.S.D $_{0.05}$	
Average of Irrigation period	D3	D2	D1	D*B	
71.29	70.10	71.16	72.60	B1	
77.23	70.12	77.19	84.39	B2	
81.66	80.51	81.39	83.07	B3	
1.85	3.20			L.S.D $_{0.05}$	
	D3	D2	D1	**Average of Irrigation period**	
	73.91	76.58	79.68		
	1.85			L.S.D $_{0.05}$	

Fiber yield (g.plant^{-1})

Table (9) indicates that the treatment B3 concentration (100 mg.L^{-1}) recorded the highest average of the trait amounted to (29.73) g.Plant^{-1}, while the control treatment without spraying the Proline acid B1 mg.L^{-1} gave the lowest average of the trait amounted to (25.44) g.plant^{-1}. This result agreed with EL Sabagh *et al.,* 2018 and Al-Rawi *et al.* (2014), as they indicated that there were significant differences when spraying with proline acid, while they did not agree with Heitholt *et al.* (2001). Also, significant differences appeared between the cultivar in (Table 9). The first cultivar (Assyria), the highest average amounted to (27.81) g.plant^{-1} compared to the second cultivar (Lashata), which recorded the lowest average amounted to (26.48) g.plant^{-1}. Table (9) also shows the presence of significant differences in the average of lint yield by the effect of different irrigation periods, where the irrigation period every 7 days was recorded the highest average reached (29.21) g.plant^{-1} compared to the irrigation treatment every 21 days that gave the lowest average of the trait amounted to (26.20) g. Plant^{-1}. The reason for this is due to the increase in soil moisture, which led to an increase in some fibre components of this treatment compared to other irrigation treatments. These results were consistent with what Sarheed (2016), Al-Rawi *et al.* (2014), Khairallah (2012), Yasser and Mohamed (2013), Karademir *et al.* (2011), Mahmoud (2004), and Matar (1985) found, indicating that there were significant differences. lint yield with the effect of different irrigation period between (Table 9) to the presence of bi-interaction significant difference between the concentration of proline acid and the cultivar, where the concentration of B3 100 mg.L^{-1} was recorded with the first cultivar (Assyria), the highest average amounted to (30.63) g.plant^{-1} Whereas, the treatment of B1 mg.L^{-1} with the second cultivar (Lashata) recorded the lowest average amounted to (23.88) g.plant^{-1}. It is noted in Table (9) that there are highly significant differences between the cultivar and the irrigation periods, where the irrigation period is given every 7 days with the first cultivar (Assyria), the highest average the trait amounted to (30.39) g.plant^{-1}, compared to the irrigation period every 21 days and the second cultivar (Lashata), which recorded the lowest average of the trait was (20.82) g. Plant^{-1}, as noted from Table (9), there was a significant interaction between the concentration of proline acid and the irrigation periods, as the irrigation period every 7 days, and the B2 50 mg.L^{-1} treatment was reached (32.02) g.plant^{-1} compared to the irrigation period every 21 days, and the B1 mg.L^{-1} treatment, which recorded the lowest average amounted to (21.33) g.plant^{-1}. Table (9) showed that there was a highly significant triple interaction between the studied factors, as the irrigation period achieved every 7 days with treatment B2 50 g. L^{-1} for the second cultivar (Lashata). The highest average amounted to (35.51) g.plant^{-1} while it achieved an Irrigation period every 21 days with treatment B1 mg.L^{-1} for the second cultivar (Lashata). The lowest average amounted to (18.18) g.plant^{-1}

Table 9 : Effect of Proline Acid Levels, Irrigation period, cultivars and interaction between them on the average Fiber yield ($g.plant^{-1}$).

Interaction	Irrigation period(day)			Proline ($mg.L^{-1}$) B	cultivars V
B*V	D3	D2	D1		
24.65	27.48	18.75	27.74	B1	V1
29.50	26.37	29.60	32.53	B2	
30.63	31.90	29.99	30.00	B3	
23.88	18.18	28.67	24.80	B1	V2
26.04	19.16	23.45	35.51	B2	
30.20	27.12	34.76	28.71	B3	
3.00	1.38			L.S.D $_{0.05}$	
Average of Proline	D3	D2	D1	D*V	
27.81	28.58	24.45	30.39	V1	
26.48	20.82	30.29	28.34	V2	
1.00	1.73			L.S.D $_{0.05}$	
Average of Irrigation period	D3	D2	D1	D*B	
25.44	21.33	24.71	30.27	B1	
27.77	22.76	28.52	32.02	B2	
29.73	29.51	30.33	29.36	B3	
1.23	2.12			L.S.D $_{0.05}$	
	D3	D2	D1	**Average of Irrigation period**	
	26.20	27.52	29.21		
	1.23			L.S.D $_{0.05}$	

References

Abdel, W.; Ahmed, I.Y. and Abdul-Jabbar Ismail Al-Habiti (2017). The role of treatment with salicylic acid and boron on growth and green yield of broad been plant. Al-Furat Journal of Agricultural Sciences, 9(3): 49-63.

Ali, E.A. and Mahmoud, A.M. (2013). Effect of foliar spray by different salicylic acid and zinc concentrations on seed yield and yield components of Mungbean in sandy soil. Asian J. of Crop Sci., 5(1): 33-40.

Alishah, O. and. Ahmadikhah, A. (2009). The effect of drought stress on improved cotton varieties in Golesatn Province of Iran. International Journal of Plant Production, 3(1):17-26.

Al-Montafaji, H.N.H. (2011). The effect of aspirin (acetylsalicylic acid) on the growth and yield of mung been *Vigna radiata* L. prone to dehydration stress. Master Thesis - University of Baghdad.

Al-Nuaimi, J.J. (2014). Partial Cross Genetic Analysis and Path Factor in Cotton (*Gossypium hirsutum* L.). PhD thesis. Technical College, Al-Musayyib, Middle Euphrates University. The Republic of Iraq.

Al-Qaisi, F.F. and Risan, K.S. (2010). Cotton's response to plant density and weeds control. Iraqi Journal of Agricultural Sciences, 41(5): 80-95.

Al-Qaisi, W.A. and Raed Muhammad Sarhan Al-Janabi (2014). The effect of spraying with aspirin (acetylsalicylic acid) on some morphological characteristics of two cultivars of *Helianthus annuus* L.). Those at risk of dehydration. Journal of the College of Basic Education, 20(84): 31-54.

Alrawi, Abdel Nasser Thabet Munir, Muayad Hadi Al-Ani and a student of Muhammad Hussein Al-Saad (2014). Cotton response (*Gossypium hirsutum* L.) to different irrigation periods and salicylic acid. Al-Anbar Journal of Agricultural Sciences, 12(2): 282-294.

Al-Shahat, N.A.Z. (2000). Plant hormones and agricultural applications, The Arab Publishing and Distribution House, second edition. The National Center for Research, Cairo, Egypt.

Al-Tayyar, Fadel Abdul-Redha (1992). Cotton, steps to cultivate it and serve the crop. Ministry of Agriculture and Irrigation, General Commission for Agricultural Services - Baghdad.

Alyas, S.K.A. (2004). Physiological study on the effect of salicylic acid in two types of soft wheat. *Triticum aestivum* L, July and Fathers 99. Master Thesis . College of Education for Pure Sciences - Dhi Qar University.

Amgad, A.E. and Hanafey, F.M. (2013). Response of three yellow Maize hybrids to exogenous salicylic acid under two irrigation intervals. Asian Journal of Science, 5(3): 264-274.

Amin, A.A.; El-Sh.M. Rashad; Fatma A.B. Gharib (2015). Changes in Morphological, physiological and reproductive characters of Cotton plants as affected by foliar application with proline acid and ascorbic acid. Austral.J.of Basic and Applied Sci., 3(4): 212-220.

Arab Organization for Agricultural Development (2013). Annual Book of Arab Agricultural Statistics - Volume (34).

Ateawy, A.A.; Farid, M.A. and Abdel-Sahib, S.J. (1990). Principles of land reclamation. Ministry of Higher Education and Scientific Research - Technical Institutes Authority.

Central Statistical Organization (2018). Directorate of Agricultural Statistics, Central Statistical and Information Technology Department, Crop Production Report, Ministry of Planning, Republic of Iraq.

Cleland, C.F. and Ajami, A. (1974). Identification of a flower - inducing factor, isolated aphid honeydew as being salicylic acid. Plant Physiol., 54: 904 -906.

Eberhard, S.; Doubrava, N.; Marta, V.; Mohnen, D. and Southwick, A. (1989). Pectic cell wall fragments regulate tobacco thin cell layer explant.

El-Sabagh, A.; Abdelhamid, M.O.; El-Menshawi, M. and El-Okkiah, S. (2018). Foliar Application of Organic Compounds Stimulate Cotton (*Gossypium hirsutum* L.) to Survive Late Sown. Condition. Open Agriculture. 10(3): 684-697.

El-Tayab, M.A. (2005) Response of barley grains to the interactive effect of salinity and salicylic acid .Plant Growth Regulation, 45: 215-224.

Guinn, G. (1974). Abscission of cotton floral buds and bolls as influenced by factors affecting photosynthesis and respiration. Crop Sci., 17: 291-293.

Hammood, W.F. (2003). The effect of plant densities and different levels of nitrogenous, phosphatic and potassium fertilizers on the yield and quality of two cultivar of cotton yield (*Gossypium hirsutum* L.). Master Thesis . Field Crop Science Department. College of Agriculture - University of Baghdad.

Hamoda, S.A.F.; Ibrahim, M.A.A. and Emara, M.A.A. (2013). Impact of water stress and planting patterns on cotton grow middle Egypt. 2nd, Alexandria International Cotton Conference. April 10-11th,2013.

Heitholt, J.J.; Schmidt, J.H. and Mulrooney, J.E. (2001). Effect of Foliar - Applied Salicylic Acid on Cotton Flowering, Boll Retention , and Yield. J. Mississippi Academy of Sci., 46(2): 104-109.

Honey, B.J. (2003). Impact of quality on the profitability of irrigated cotton production on the Texas height plains. National cotton. J. (1): 216-222.

Howard, D.D.; Mike, E.E.; Robert, M.H. and Wyveta, M.P. (2001). Potassium fertilization of conventional-and no–till cotton. Journal of Cotton Science,5 : 197–205.

Hussain, R.M.H. (2007). Influence of pixel, phosphorus and potassium chloride levels on cotton growth, yield and quality. PhD thesis. College of Agriculture - University of Baghdad.

Issa, T.A. (1990). Roots, Nutritional, Water Flow, and Plant Growth, translated by Editor of the symposium (David M. Karal) College of Agriculture - University of Baghdad.

Jassim, A.H. and Naeem, S.M. (2013). The effect of concentration and treatment method with salicylic acid and ascorbic acid on leaf content of chlorophyll and proline for broad been plant in salinity soil. Al Furat Journal of Agricultural Sciences, 5(2): 150-156.

Jassim, A.H. and Nagham, A.A.M. (2015). The effect of cultivated dates and spraying of some Catalysts and their interaction on the leaf content of chlorophyll and the nutrients of the mung been. *Vigna radita* L. Karbala University Scientific Journal, 13(1): 16-20.

Jenkins, J.N.; Mccarty, J.C. and Parrott, W.L. (1990). Effectiveness of fruiting site in cotton yield. Crop Sci., 30: 365 – 369.

Joseph, B.; Jini, D. and Sujatha, S. (2010). Biological and physiological perspectives of specificity in abiotic salt stress response from various rice plants. Asian J. Agric. Sci., 2: 99-105.

Karademir, C.E.K.R.E. and Berekatoglu, K. (2011). Yield and fiber quality properties of cotton (*Gossypium hirsutum* L.) under water stress and non-stress conditions. African. J. Bio. 10(59): 12575-12583.

Kaydan, D.; Yagmur, M. and Okut, N. (2016). Efect proline acid Of the growth and some pahysiological characters in salt stressed cotton (*Gossypium hirsutum* L.) Ankara University, Ziraat, 13(2): 114–119.

Kerby, T.H. and Adams, F. (1985). Potassium Nutrition of cotton. P. 843–860. In R. D. Munsson (ed.) potassium in ariculture. ASH, CSSA. And SSSA. Madison, WI.

Khairallah, M.A.Y. (2012). Response of some cultivar and hybrids derived from them for the two irrigation periods. Master Thesis, College of Agriculture - University of Baghdad.

Khan, W.; Prithviraj, B.; and Smith, D.L. (2014). Photosynthetic responses of cotton to foliar application of Proline.J. Plant Physiol, 165: 234-241.

Khodary, S.E.A. (2004). Effect of Salicylic acid on the growth, Photosynthesis and carbohydrate metabolism in salt stressed maize plants. Int. J. Agric- Biol., 6: 5-8.

Lee, Y.Sh. (2003). Improving water use efficiency of irrigated crops in the North China. Indian. J., 88: 272-298.

Mahmoud, Y.N. (2004). Response of some *Gossypium hirsutum* L. cotton genotypes to different irrigation periods after flowering. Master Thesis - Faculty of Agriculture - Tikrit University.

Matar, H.K.A. (1985). The effect of irrigation periods and plant densities on yield and qualitative traits of cotton cultivar Coker 310. Master thesis - College of Agriculture - University of Baghdad.

Ministry of Agriculture - Republic of Iraq - National Committee for Agricultural Varieties Registration. 2004. Annual bulletin of registered and approved varieties in Iraq. Issue (3): 74.

Onder, D.; Akiscan, Y.; Onder, S. and Mert, M. (2009). Effect of different irrigation water level on cotton yield and yield components. African Journal of Biotechnology, 8(8): 1536-1544.

Popova, L.; Pancheva, T. and Uzunova, A. (1997). Salicylic acid : Properties, Biosynthesis and physiological role. Bulg. J. Plant Physiol., 23: 85-93.

Rao, S.R.; Qayyum, A.; Razzaq, A.; Ahmad, M.; Mahmood, I. and Sher, A. (2012). Role of foliar application of salicylic acid and L- tryptophan in drought tolerance of MAIZE. The Journal of Animal & Plant Sciences, 22(3): 768–772.

Sakhabutdinova, A.R; Fatkutdinova, D.R.; Bezrukova, M.V.; Saleh, M.I. and Amjad, T.K. (2012). *Gossypium hirsutum* L. cotton growth and yield response to cultivation distances, addition fractionation and nitrogen fertilization levels. Jordanian Journal of Agricultural Sciences, 8(2): 253- 265.

Sarheed, A.F. (2016). Stability study and path coefficient analysis for abland cotton varieties (*Gossypium hirsutum* L.)) under site influence and two irrigation periods. Master Thesis. Middle Euphrates Technical University. The Republic of Iraq.

Sarkis, N.O. and Rajaa, M.H.H. and Makiya, K.A. (2012). The response of the Lasha cotton cultivar to spraying times and different levels of Mebcoat chloride (Pix) A - growth, yield and components. Tikrit University Journal for Agricultural Sciences, 12(1): 110-120.

Shafshaq, Salah Al-Din Abdel-Razzaq and Abdel-Hamid Al-Sayed Al-Debabi (2008). Field crops production. Cairo. Arab Thought House. 323-378.

Shaker, A.T. (1999). Crops of Fibers, Directorate of Dar Al Kutub for Printing and Publishing, University of Mosul, Ministry of Higher Education and Scientific Research.

Shakirova, F.M. (2003). Salicylic acid prevent the damaging action of stress factors on wheat plant. Blug. J. Plant Physiol., 21: 314–319.

Shakirova, F.M. (2003). Salicylic acid prevent the damaging action of stress factors on wheat plant. Blug. J. Plant Physiol., 21: 314–319.

Shalaby, M.A.F.; Ahmed, M.A.; Abdallah, M.S.A. and El-Housini, E.A. (2017). Physiological Role of Proline Acid in Improving Growth and Productivity of cotton (*Gossypium hirsutum* L) Under Sandy Soil Conditions. Middle East Journal of Agriculture Research, 3(4): 78-84.

Siddiqui, M.H.; Oad, F.C. and Buriro, U.A. (2007). Response of cotton cultivars to varying irrigation regimes. Asian Journal of Plant Sci., 6(1): 153-157.

Soomro, A.; Mirjat, M.S.; Oad, F.C.; Soomro, H.; Samo, M.A. and Oad, N.L. (2001). Effect of irrigation intervals on soil salinity and cotton yield. Online Journal of Biological Sci., 1(6): 472-474.

Troshina, N.B.; Maksimov, I.V.; Iaruline, L.G.; Surina, O.B. and Cherepanov, E.A. (2004). Plant resistance inductors and active Form of oxygen. I. The influence of salicylic acid on growth, anatomy and physiological feature of wheat plants. Article in Russian, 46(11): 100–105.

Verma, S.K. and Verma, M. (2010). A Text Book of Plant Physiology, Biochemistry and Biotechnology. S. Chand and Company Ltd. Ramangar.

Wainland, R. and Taylor, H.E. (1965). Phenols as plant growth regulators. Nature, 207: 167-169.

Yasser, Musab Abdel-Ilah and Leila, I.M. (2013). The strength of hybrid in cotton under the influence of the two irrigation periods. Iraqi Agricultural Science Journal, 44(1): 43-57.