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Effect of abscisic acid and superabsorbent polymer on tolerance of *Abelmoschus esculentus* to drought

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ABSTRACT

The experiment was conducted during the agricultural season (2016-2017) to study the effect of paper spraying with Abyssic acid and mixing polymers with soil to grow the *Abelmoschus esculentus* under different irrigation periods. The experiment developed with the design of complete random sections as a global experiment with three replicates. The first factor included irrigating factors (irrigations 3, 6, 9) day and spray agent with Abyssic acid at concentrations (0, 3, 6) mg / L and the third agent mixing polymers with soil, Soil mixed with polymers (0.5 kg / m2) with a depth of 20 cm. The results showed that the increase in the duration of the irrigation period to 9 days resulted in a decrease in the characteristics of the study (dry weight, chlorophyll content, relative water content in leaves) and a clear increase in the percentage of water deficit in the soil while irrigation every 3 days significantly exceeded the studied traits. The results showed that spraying plants with Abyssic acid and its different concentrations, especially 6 mg / L, led to a clear increase in the traits studied. Mixing the soil with polymers has led to a marked improvement in the studied indicators and increased plant resistance to water scarcity. Interaction factors between the duration of irrigation with alfalfa and the addition of soil polymers showed a significant effect on most studied traits.

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INTRODUCTION

The plant is exposed to harsh environmental conditions during its life cycle such as drought, temperature variation and intensity of light affect the process of girls' physiological processes. Drought stress is one of the most severe problems facing agricultural expansion in different regions. Water consumption for agriculture is dominated by other consumption. Especially afforestation projects in cities, despite their importance, but lead to a large consumption of water resources (Sadik *et al.,* 1997). Water stress causes several damages to plants, including the degradation of cellular membranes and the destruction of protoplasm and proteins, leading to mutations (Schuize *et al.,* 2002). In addition to changes in the percentage of water associated with cellular membranes and a lack of bloating pressure on the cellular wall, which affects the physiological, phenotypic, biochemical and molecular properties of the plant (Jagadees waran *et al.,* 2009).

To reduce the effects of drought and rationalize water consumption, it is necessary to use modern techniques, including spraying plants with abyssic acid, a hormone that plays a major role in regulating plant response to stress. Sharp (2002) noted that the Abyssic growth regulator has a role in regulating physiological processes including maintaining the water content of the plant by controlling the process of opening and closing the stomata. Pei and Kutichsu (2005) show that the effect of ions in an organization of the process of opening and closing of stomata is linked to the action of the Abscess, as it increases the concentration of calcium ion in the cell cytoplasm and prevents the entry of potassium and activates the negative ions for extrusion. The spraying of plants with Abyssic acid increases the ingestion and absorption of water and consequently preserves the plants from wilt and increases their ability to withstand water stress. Kang and Zhang (2004) explained that abyssic acid is an anti-transpiration inhibitor that reduces the rate of transpiration Plant exposure to drought. Mutri and others (2004) confirmed that abscisic acid stimulates a range of responses that prepare plants for water shortages, such as increasing the root mass and decreasing the number of stomata.

Polymers are extremely absorbent from modern agricultural techniques used to improve the physical properties of soil in terms of increasing their water retention capacity, reducing the number of watering times, and improving plant characteristics, particularly in areas of drought and water scarcity (Tally and Atassie, 2015). When used in agriculture, polymers increase soil capacity, lead water efficiency, reduce the watering rate, and improve soil permeability (Chirani and others, 2015). Zahra and others. (2011) reported that treatment of yellow maize plants with polymers cultivated under different levels of water stress increased plant resistance to stress and vegetative traits, crop and components.

Abelmoschus esculentus, a large-scale summer vegetable crop in Iraq, is distinguished from the rest of the crop with its highly desired yield among the most populous population (required and others, 1989). The fruit of the Bamaya is a good source of nutrients, carbohydrates and minerals, a group of vitamins in addition to containing a high proportion of fibre important in the maintenance of sugar and cholesterol in the blood (Kumar and others, 2010). In order to improve the productivity of plants underwater conditions, methods were used to reduce water consumption, including paper spraying with Abyssic acid and soil mixing with high absorbent polymers. This is the goal of this study.

MATERIALS AND METHODS OF WORK

This study was conducted during the agricultural season 2016-2017 to study the effect of spraying with abscisic acid and adding the soil polymer in the resistance of the plant to drought. Field soil was prepared and analyzed physiologically and chemically before experimentation. The soil was divided into a 10 m long and 50 cm moss. Seeds were planted on both sides of the meadow and 30 cm between one plant and another. All agricultural service operations were carried out by fertilizing and cultivating the length of the planting season and according to plant requirements. The experiment was carried out according to the design of random sectors and three replicates. Three factors were used to spray the plants with Abyssic acid with concentrations of (3, 6) mg / L in addition to the coefficients of sprinkled with distilled water only. The second factor is mixing plant water gel crystal with soil (without adding polymers to the soil, adding polymers to the soil) and by 0.5 kg / m at a depth of 20 cm in the soil, In addition to factor irrigation periods and three periods (3, 6 and 9) days. Irrigation periods were determined by calculating the soil capacity of the soil by taking 100 g of soil and drying it at 105 m for 24 hours using the electric oven. Then weighted to represent the dry weight and the amount of moisture content according to the equation:

$$\text{Percentage of soil moisture based on dry weight} = \frac{7et\ we;ght - Dry\ we;ght}{Dry\ we;ght} \times 100$$

The following characteristics were studied:

1. Dry weight of plant (g). Four plants were taken from each coefficient and cleaned well-using water from the soil. Then the plants were dried in the air first and then placed in perforated paper bags and placed in the electric oven at a temperature of 70 m for 48 hours (until proven weight) and then weighed using the sensitive balance and dry weight.
2. Determination of total chlorophyll content.The total chlorophyll content was estimated according to the method used (1941, Mackinney and 1949, Arnon). Take 1 g of fresh plant leaves and crushed in a ceramic mortar and add 10 ml of acetone (80%). The leachate was separated from the precipitate by a centrifuge at 3000 cycles/minute for 15 minutes. The extraction was re-extracted by adding 10 mL of acetone also like in the previous method itself. I read the absorbance on the standard wavelengths (645 and 663) nm using the Spectrophotometer and then estimated the content of the sheets of chlorophyll according to the following equation:

   Total Chlorophyll mg /g fresh tissue= $[20.2(D_{645}) +8.02(D_{663})]\ xV/1000xW$
3. Relative water content of leaves RWS% Based on the method Taiz and Zeiger (2002), a number of leaves were taken from different places of the plant and weighed using the delicate balance and then placed in a flask filled with distilled water for 12 - 14 hours until the paper was saturated with water and then weighted to represent the full weight. The leaves were placed in the oven at 85°C for 3 hours and weighted to represent the dry weight. And estimated according to the following equation:

$$RWS = \frac{Fw - Dw}{Tw - Dw} \times 100$$

4. Determination of water saturation deficit. The rate is calculated according to the following equation:

Water saturation deficit = (100 - RWS)

RESULTS AND DISCUSSION

The results of Table (1) showed that there were significant effects of the factors under study in the dry weight rate. It showed that irrigation every three days recorded the highest dry weight of the plant while irrigation after 9 days showed a clear decrease in dry weight in both treatments by adding or not adding polymers of the soil. While spraying with abscisic acid significantly increased the dry balloon with increased concentration. The results as well showed that mixing the soil with polymers caused weight gain and reduced the effect of low water quantity. In relation to the interactions, the plants were treated with a 6-mg / L 6-mg irisic acid, which was grown in soil containing the highest dry weight of the plant. While the lowest rate was treated with APSIC at 0 mg / L and irrigated after 3 days, Free of polymers.The results of Table (2) showed significant effects of Irrigation period coefficients. A gradual decrease in total chlorophyll content was observed with increased irrigation period. While an increase in total chlorophyll content was observed when spraying the plants with abscisic acid and its different concentrations and adding polymers to the soil. The results showed that the addition of polymers to the soil and sprayed the plants with different concentrations of abscisic acid, especially at a concentration of 6 mg / l reduce the negative effects of the increase in irrigation periods.

With regard to the relative water content, which is one of the indicators of water stress and is associated with soil water content, the results of Table (3) indicate that there are significant effects of the factors under study in the percentage of water content in the leaves. The relative water content in the leaves decreased with an increase in the number of days between irrigation and another. The lowest water content in the leaves during the irrigation period after 9 days was 63.41%. While the spraying of acid Albesisik and different concentrations to increase the water content of papers, and the same effect recorded the addition of polymers to the soil, recording the highest value of 74.46% compared to the addition of polymer to the soil. The effect of irrigation was 3 days and spraying with abyssic acid at a concentration of 6 mg / L and the addition of polymers to the soil. The highest water content of the leaves was 82.11% while the lowest percentage was 60.00% 9 days and acid Albesisik concentration of 0 mg / l without the addition of polymers to the soil.
It clarifies from Table (4) that the increase in the period between irrigation and other caused a clear decrease in the rate of water saturation deficit. The irrigation treatment after 9 days recorded the highest rate of water tax (34.66%) when the polymers were not added to the soil while the effect of the lack of water was observed when adding polymers to the soil with a water saturation deficit (26.76%). The spraying of plants with abscisic acid showed a marked reduction in water deficit in line with the increased concentration used and the lowest concentration at 6 mg / L. Interactions The irrigation combination was recorded 3 days after spraying the plants with Albesecic at a concentration of 6 mg / L with the addition of polymers to the soilless (17.09%) of the water deficit.

It is clear from the above results that increased periods of irrigation negatively affected the qualities studied and the reason for the lack of dry weight to the lack of moisture in the soil, which led to a decrease in the effectiveness of photosynthesis and reduce the amount of metabolic products transferred to the root and consequently lack of root growth and this reflects negatively on the amount of water absorption Nutrients from soil and their delivery of vegetation (Geetha and others2012). In addition, the lack of root growth led to a lack of ability of plants to absorb water and therefore lack of relative water content of leaves and high water deficit (Ghaffar and others, 2012). The decrease in the total chlorophyll content in the leaves during increased irrigation periods because the lack of water has inhibited the growth of green plastids due to the lack of root absorption of the elements, especially the nitrogen, which is a component of the chlorophyll molecule (Levitt, 1980). All these factors negatively affected the amount of plant yield in addition to reducing the area of the paper due to drought. These results are consistent with the findings of Rauf, Sadqat (2008), Vanaja and others (2011) on the effect of low water level on different plants. It is also noted that the spraying of plants with different concentrations of abscisic acid led to a significant increase in the dry weight of the plant. This is due to the role of Abyssic in promoting the growth of lateral branches of the roots and increase the area of its spread in the soil and thus increase the amount of absorption of water and nutrients from the soil, to increase yields (Sharp, 2002). The increase in chlorophyll content in the use of abscisic probably because of its role in improving the accumulation of pigments and maintaining their stability by increasing the activity of antioxidant enzymes (Gadallah, 1995). The increase in the relative water content of the leaves

Table 1: Effect of spraying with abscisic acid and addition of soil polymers, irrigation periods and interference in dry weight (g)

Irrigation periods (day)	Without adding polymers to the soil				Add polymers to the soil			
	concentration Episic acid ml/l			Effect of irrigation periods	concentration Episic acid ml/l			Effect of irrigation periods
	0	3	6		0	3	6	
3	15.7	16.93	16.98	16.54	15.72	17.03	17.98	16.91
6	14.33	16.07	17.21	15.87	15	16.63	17.32	16.32
9	10.07	12.39	12.99	11.82	13.32	14.75	16.07	14.71
Rate of Effect of Epispec	13.37	15.13	15.73		14.68	16.14	17.12	
Polymer effect rate	14.74				15.98			

Table 2: Effect of spraying of abyssic acid and addition of soil polymers, irrigation periods and interference in total chlorophyll content (mg / g wet weight)

Irrigation periods (day)	Without add polymers to the soil				Add polymers to the soil			
	concentration Episic acid ml/l			Effect of irrigation periods	concentration Episic acid ml/l			Effect of irrigation periods
	0	3	6		0	3	6	
3	39.31	41.03	42.93	41.09	39.71	45.11	46.27	39.31
6	34.07	34.29	38.47	35.61	38.01	40.23	41.76	34.07
9	30.76	33.31	36.33	33.47	36.10	39.01	40.08	30.76
Rate of Effect of Epispec	34.71	36.21	39.24		37.94	41.45	42.70	34.71
Polymer effect rate		36.72				40.70		

Table 3: Effect of spraying with abscisic acid and addition of soil polymers, irrigation periods and interference in water content

Irrigation periods (day)	Without polymers to the soil				Add polymers to the soil			
	concentration Episic acid ml / l			Effect of irrigation periods	concentration Episic acid ml / l			Effect of irrigation periods
	0	3	6		0	3	6	
3	68.11	75.17	78.30	73.86	78.19	80.37	82.11	80.22
6	63.05	62.66	75.73	67.15	70.03	72.00	75.31	72.45
9	60.00	63.51	66.72	63.41	66.42	70.10	75.59	70.70
Rate of Effect of Epispec	63.72	67.11	73.58			75.82	78.34	
Polymer effect rate		68.14				74.46		

Table 4: Effect of spraying with abyssic acid and addition of soil polymers, irrigation periods and overlaps in average water saturation deficit (%) for Abelmoschus esculentus

Irrigation periods (day)	Without polymers to the soil				Add polymers to the soil			
	concentration Episic acid ml/l			Effect of irrigation periods	concentration Episic acid ml/l			Effect of irrigation periods
	0	3	6		0	3	6	
3	21.81	24.21	22.65	22.89	19.35	19.82	17.09	18.75
6	36.91	35.35	28.59	32.95	21.81	20.14	17.31	19.75
9	39.03	36.44	28.50	34.66	29.92	27.36	23.00	26.76
Rate of Effect of Epispec	32.58	31.33	26.58		23.69	22.44	19.13	
Polymer effect rate		30.17				21.76		

and the lack of water saturation in the use of abscisic acid is due to its role in the partial closure of the gaps and therefore the loss of water through the transpiration, adding to the growth of vegetative and rooting, which increases the amount of water absorbed from the soil (Unyayar and others, 2004). This corresponds to the results of Luan (2002) and Shinohara (2014) in their study on different plants. Majeed et al. (2011) also noted that the treatment of plants with Abyssic acid leads to an increase in the relative water content, which is positively reflected on the yield and its components, in addition to increasing the water use efficiency of the plant. With regard to the positive effects of adding superabsorbent polymers to the soil, it is because of its role in preventing water permeation into the soil depths away from the root mass and therefore maintaining water standby and humidity content in the soil for a longer period when the plants are exposed to water reduction (Tally and Atassie, 2015). Liu and others (2017) that manure contains polymers is one of the most important mechanisms to keep the content of water in the soil.

CONCLUSION

We conclude from the study that the lack of water from the quantity needed by the plant during the life cycle affect the conduct of many of the necessary physiological processes, which adversely affect the growth and productivity of the plant. The use of Abyssic acid reduced the rate of plant transpiration through its role in partial closure of the gaps, therefore the diaper on the water in addition to its role in increasing the growth of roots, which leads to increase the absorption area. The addition of polymers to the soil increased soil capacity to hold water, improve soil permeability and reduce irrigation in large quantities and consequently reduce water consumption when watering plants.

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