Plant Archives Vol. 19, Supplement 1, 2019 pp. 387-391 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

GROWTH OF SOME OIL YIELDING CROPS UNDER MOISTURE STRESS EFFECT

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Abstract

Two field experiments were carried out in the plant garden that belongs to science department, College of Basic education, University of Al-Mustansiriyah, Iraq, during winter season of 2017/2018 to study effect of irrigation intervals on safflower and flax plants to moisture stress tolerance. The two experiments were done by using randomized completely blocks design (RCBD) and three replicates were used .The study included using one way which was irrigation intervals (one, two and three weeks).
The results of these two experiments were as follow :

Irrigation intervals caused significant decrease of the following growth parameters of safflower crop, plant height, root length, wet weight of the vegetative parts, wet weight of the roots parts, dry weight of the vegetative parts and dry weight of the roots part in decrease percentages reached 35.63%, 22.22%, 50.60%, 40.02%, 62.57% and 56.09% respectively compared with weekly irrigation treatment.

In flax crop, the decrease percentages in the last mentioned growth parameters were 42.89%, 50%, 80.82%, 80.82%, 80.76% and 69.85% respectively except dry weight of root part property which had not been affected significantly by irrigation intervals.

Key words: Drought, moisture stress, traits, flaxseed, Safflower*, Carthamus tinctorius, Linum usitatissimum.*

Introduction

Drought is considered as one of the most important challenges that faces the world agricultural production, especially in the dry and semi-arid regions including Iraq. Iraq is suffering from rains distribution variances, so in such condition the productivity will decrease and hesitates from year to year according to water depth average and its distribution. Increase areas of these regions and decline of water resources make us seriously think in searching of kinds of crops that can tolerate these conditions and produce best yield with less possible water uses. The flax and safflower crops were selected because they are winter and oily crops that need low water requirements compared with other winter crops beside the summer oily crops that compete on the water share (Hussien and Wuhaib, 2010).

Safflower is an annual and oily crop that grows widely around the world and it grows largely in Iran, Afghanistan, Pakistan, India and other regions, and the produced oil from its seeds includes 12% of the oil world production. Its seeds and flowers petals contain pharmaceutical materials that have wide medical uses and, from its flower it may be got water soluble yellow stain and water insoluble red stain .These stains may be used in silky cotton fabric staining (Wuhaib, 2007). Safflower may take important role in reduction of blood cholesterol level due to its high unsaturated fatty acids content, and it tolerates saline and dry conditions due to its non-sensitivity to weather temperature resulted from its root system expanding and it can substitute the lost moisture making the crop retaining to its water requirements besides it has waxy leaves surface that decreases plant moisture loss.

It is possible to achieve to highest productivity by decreasing of irrigation numbers and relating quantity of the given water in each irrigation with soil water holding capacity and the active need of water in different plant growth stages for plant deep roots formation and improvement their ratio to the upper parts, it must be determined the irrigation water addition and reduces moisture ratio and then it may be got productivity increase of safflower crop (Hussien and Wuhaib, 2010), this agrees with findings of (Abdl Hassan and Mohamed, 2013) who indicated that the main parameter of plant ability to give higher seeds yield with less water consumption .

Flax crop is considered as double purpose crop which is planted for oil and fibers or both together, and the oil percentage in the seeds is 30-40, the flax oil has high content of linoleic (50%), oleic acid (23%) from total of the relative unsaturated acids (AL-Baddrani *et al.*, 2012).

The stress and drying cause turbulence and balance absence in plant activities and they have negative effects on plant growth and, they cause vegetative and productive growth reduction though inhibition photosynthesis operation and disruption nitrogen metabolism and its role in increasing production of reactive oxygen species which work on protein and cellular membranes destruction (Hameed, 2016) .

The aim of this study is test of safflower and flax resistance range to stress and dryness and the effect range on the growth parameters of these two crops.

Materials and Methods

Experiment location, study factors and the experimental design.

Two field experiments were carried out during winter season (2017-2018) in the plant garden belongs to Science Department, College of Basic education, University of Mustansiriah, Baghdad city which is located within 33.19N – attitude, 44.25E – longitude and 32 meters height on sea surface to study effect of irrigation intervals on safflower and flax crops tolerance of the moisture stress. The two experiments were done using the randomized completely blocks design (RCBD) with using three replicates. The study included using one factor which is irrigation intervals each one, two and three weeks.

Soil Preparation

The soil was plowed by two vertical plowing and then it was grinded, leveled and divided into plots (1*1 dimensions) and 30cm distance was left between plot and plot and another one meter distance between the replicates to prevent water and fertilizer seepage between them. The experiment was divided into three treatments which were irrigation intervals (three replicate for each treatment and, the irrigation intervals were irrigation every one, two and three weeks. The seeds of the two crops were planted in November, and then irrigation process was done to all the experimental units after planting completion till emergence completion. After that irrigation was done in its intervals by scaled bucket to measure quantity of the applied water to each secondary experimental unit for control of water quantity in each irrigation and for estimating quantity of the used water in crops irrigation in each treatment in which was fifteen liters. The chemical fertilizers were added according to the fertilizers recommendation of each crop.

The Studied Properties

- **Plant height (cm)**: It was done by measuring safflower plants height from soil surface to highest limit (Hameed, 2016).
- **Root length (cm)** : The roots were cut by using a cylinder (70 cm height * 25 cm diameter) which was stitched to 50 cm depth. After cylinder lifting, the root were cleaned by water and passed a sieve (2 mm- diameter) (Hussien and Wuhaib, 2010).
- **The wet weight of the vegetative and root parts:** It was done using sensitive balance.
- **The dry weight of the vegetative and root parts:** It was done by measuring the dry weight of the plant parts after oven drying at 80 ºC for two days until we got constant weight.

The statistical analysis

The data was analyzed according to the randomized completely blocks design (RCBD).

Results and Discussion

Effect of irrigation intervals on height of safflower and flax plants

Plant height represents one of plant growth parameters which indicate to dry matter increase when there is suitable space to receive sun rays by leaves (Hmood, 2010), the plant height may increase due to competition increase between crop plant and weeds on light at high plants densities.

The results in table (1) show that irrigation had significant effect on plants height, and the plant height decreased in two weeks and three weeks irrigation intervals at 27 and 35.6% rate compared with one week irrigation interval, and this result is natural due to water shortage that resulted from low quantities of irrigation water and in turn this may decreases roots distribution in the early stages of crop growth (Elsahookie *et al*., 2006).

The reason of plant height decline due to water shortage may be due to water stress during vegetative growth stage in which stem elongation and expansion of stem is low because of water stress decline of the water cells which are connected with soil water availability decrease beside photo destruction of the Oxin as a result of plant cover reduction, light entry in large quantities and there was no chance to prove to it to work on internodes elongation, these in turn works on plant height decrease (Falih and Salih, 2012). This indicates that plant height is correlated with harmonic factors or growth regulators beside its connection with other environmental factors. These results agreed with finding of Cakir (2004) who mentioned that the water stress during vegetative growth period caused plant height decline as are sult of water shortage effect on division and elongation of cells.

In flax plant, the results in table-2- refer of presence a significant effect of irrigation in plant height and it decreased in irrigation treatments, each two weeks or three weeks in 20.1 and 42.8% ratio compared with one week irrigation interval treatment, this is considered a natural result as plant height decrease is a result of decrease of vascular numbers or their volume or both of them due water shortage and no ability of plant to absorb and use of nutrients minerals in water , this result agrees with results of Ahmad (2012).

Effect of irrigation intervals in root length of flax and safflower plants.

Studies of the roots properties are considered few or limited in water stress direction in spite of their importance in drought resistance and morphology of the root system differs between one type to another and it is limited by genetic type and correlated largely with the environmental condition as drought causes gradual shortage in root elongation average (AlSaidi, 2005).

The results in table (1) refer to significant effect in root length, and two weeks irrigation treatment gave higher root length average than weekly irrigation and three weeks irrigation treatments and they were 8.26 and 28.9% respectively, this results agree with results of (Hussien and Wuhaib, 2010) when they used two, four and six weeks irrigation treatments and they found superiority of irrigation every 4 weeks in giving the highest roots length.

Crafts (1968) indicated presence of light relation between roots density in soil and soil drought, and he mentioned that when irrigation delayed till permanent wilting point then the plants roots near soil surface will die, and the nutrient elements absorption will be limited by the new roots that present in the deep regions of soil and in such circumstances the growth may be inhibited completely and plant growth average stays low in re-irrigation (AlSaidi, 2005).

In flax plant, the results in table (2) refer to significant effect of irrigation on root length. The root length decreased in two weeks and three weeks irrigation treatments at 41 and 50% ratio respectively compared with the weekly irrigation treatment, and this result is considered as natural result due to the resulted water shortage effect from irrigation quantity shortage.

Table 1 : Effect of irrigation intervals in growth traits of safflower plants

irrigation intervals	Plant height (cm.)	Root length (cm.)	Wet weight of vegetative part (gm.)	wet weight of the root part(gm.)	Dry weight of vegetative part (gm.)	Dry weight of the root part (gm.)
One week	94.3	18.0	117.1	7.62	16.70	1.64
Two week	68.7	19.7	81.4	4.79	9.59	0.79
Three week	60.7	14.0	57.5	4.57	6.25	0.72
L.S.D 0.05	15.5	7.50	18.3	1.81	5.37	0.37
C.V	9.2	19.2	9.5	14.1	21.9	15.6

Table 2 : Effect of irrigation intervals in growth traits of flax plants

irrigation intervals	Plant height (cm.)	Root length (cm.)	Wet weight of vegetative part (gm.)	wet weight of the root part (gm.)	Dry weight of vegetative part (gm.)	Dry weight of the root part (gm.)
One week	82.30	12	16.27	1.04	2.82	0.29
Two week	65.70	7	6.97	0.40	1.43	0.15
Three week	47.00	6	3.12	0.20	0.85	0.14
L.S.D 0.05	8.28	4.13	6.78	0.42	1.19	NS
C.V	5.6	21.9	34.1	34.3	30.9	38.2

Effect of irrigation intervals in the wet weight of the vegetative part of safflower and flax plants

Table (1) shows that delaying irrigation for two weeks or three caused decrease of the wet weight of safflower plant, and the wet weight in irrigation weekly was 117.1 g plant with decline ratio reached 31 and 51% of the wet weight compared to the weekly irrigation treatment, and this indicates to the role of the water shortage in plant growth, and the drought results stomata closure and limits gases exchange (Jones and Qualset, 1984). Decrease of growth under stress conditions was caused from damage of most of the biochemical and physiological operations such as respiration (Nultscl, 2001), photosynthesis (Chaerle *et al*. 2005), water and ions absorption (Supper, 2003) and transport of the metabolized elements and hormones

work (Schmitz and Schutte, 2000) and these operation may definitely cause decline in plant growth, surface area and the crop economic return.

In flax plant, table (2) refers to presence of significant effect of irrigation on the wet weight of the vegetative part, and the dry weight declined in two weeks and three weeks irrigation treatments to 6.97 and 3.12 g plant at 57.1% and 80.8% ratio compared with the weekly irrigation treatment which was 16.27 g plant^{-1}.

Effect of irrigation intervals on the wet weight of the root part of safflower and flax plants

Results of table (1) indicate decline of the wet weight of the root part of safflower crop with diverge of irrigation intervals to two weeks or three weeks and the wet weight declined to 4.7 and 4.5 g plant^{-1} rates with decline ratio reached 37.1 and 40% respectively compared with weekly irrigation treatment which was 7.6 g plant $^{-1}$, this may be due to soil water stress suffers shortage in which its degree depends on the water stress level and as a result of that it will be difficult to water to be absorbed by plants and then the plant water stress is reduced (Boyer, 1982). Soil water shortage with water stress of plant tissues water stress decline may cause plant physiological (damages and then root growth decrease (Jemison and Williams, 2006), this was emphasized by Hmood (2010) who found decline in wet weight of roots with irrigation intervals keeping away.

In the flax plant, the results of table (2) indicate presence of significant effect of irrigation on the root part wet weight and it declined in two weeks and three week irrigation intervals treatments to 1.04 and 0.20 g plant^{-1} at rates of 64% and 84% respectively compared to weekly irrigation treatment which was high.

Effect of irrigation intervals on the vegetative part dry weight of safflower and flax plants.

The result of table (1) refers to presence of significant effect in the dry weight and the dry weight of the vegetative part in the two and three weeks irrigation intervals treatments at rates of 42.5% and 62.5% compared to the weekly irrigation treatment, it is perhaps natural result as plant dry weight decline was due to the biological process beside decrease of the important elements absorption in the biological processes in addition to the direct effect of available water soil content decrease and this obstructs the plant natural growth and decreases dry matter accumulation or may that vegetative part dry weight decline relates to soil shortage over the real capacity and this shortage in dry matter is proportionately progressively with transpiration shortage and water shortage in the leaf (AlFatlawiand AlSaamak, 2013).

In flax plant, the results in table (2) refer to significant effect presence of irrigation on the vegetative part dry weight. It decreased in two weeks and three weeks irrigation treatments at 49.2% and 69.8% respectively compared with the one week irrigation treatment, this result agrees with results of Hussien and Wuhaib (2010) who found increase in dry matter yield with number of irrigation in compare with no irrigation treatment, and this may be considered as natural result as the water stress results decrease of the plant dry matter due to root growth and penetration shortage and vegetative growth shortage.

Effect of irrigation intervals on root part dry weight of safflower and flax plants

There was a response in root dry weight property with irrigation number increase and this agrees with finding of Alati (1999) due to water role in the different plant biological process as the very low levels work on stoppage of root growth and cells elongation

Table (1) refers to presence of significant effect of irrigation on safflower root part dry weight. The root parts dry weight decreased in two weeks and three weeks irrigation intervals treatments at 56% and 51.8% rates compared with the weekly irrigation treatment which was high.

In flax plants, the results in table (2) referee to non-significant differences between the treatments in root part dry weight.

Conclusions

From results of this study, it may be concluded that:

- The decline ratio of the studied properties in flax plant was larger than safflower plant and this means that safflower plant was more tolerance to irrigation intervals diverge than flax plant.
- There were no significant differences between irrigation every two weeks and three weeks in all the studied properties.

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