The Effect of Deficit Irrigation on Seasam Growth, Yield and Yield Components in Drought Conditions on base of sustainable agriculture

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ABSTRACT: In order to determine the best irrigation frequency on economic production of sesame in Jiroft area an experiment was conducted as Randomized Complete Block design with seven treatments in three replications from 2010, for two years. In this experiment treatments were consist of I1) irrigation frequency on the basis of farmer conditions, I2) irrigation frequency after 90 mm evaporation from pan, I3) irrigation frequency after 120 mm evaporation from pan, I4) irrigation frequency after 150 mm evaporation from pan, I5) irrigation frequency after 180 mm evaporation from pan after flowering phase and irrigation frequency after 90 mm evaporation from pan before flowering phase and I6) irrigation frequency after 180 mm evaporation from pan before flowering phase and irrigation frequency after 90 mm evaporation from pan after flowering phase. After harvest, yield (kg/ha) and yield components were measured. Results showed that irrigation frequency treatments had significant effect on yield, yield components, plant height and number of branch. by increasing time distance between irrigation frequency yield, yield components and plant growth decreased so that maximum of these parameters obtained from I2. However the most important finding happened in I7, that according to sever water deficiency conditions in area, along with saving 1000 m3/ha water could produce considerable yield after I7, that yield difference between I2 and I7 treatments was 100 kg/ha.

Keywords: deficit Irrigation, drought, Sesame, Yield, Yield component

INTRODUCTION

Cultivation of oil seeds has been an important part of agriculture in the world. Increasing of these plants production from 35 to 160 million tons in 1970-1980 is the evidence of their importance. But in this period oil seeds production in Iran not only did not increase but decreased, unfortunately. When the importance of investigation on oil seeds is recognized that we know 90% of consume oil is imported (Najafi & Saffari, 2011). Sesam is an oily plant that preffers tropic climate. Sesam oil is one of the best edible oils (Khaje pur, 1994). The sesam cultivated area in Jiroft & Kahnooj region is about 6000 ha and it is increasing now. This plant as a summer crop is in patch and cereals rotation in Iran and water deficiency is one of the main factors involving in sesam production decrease. In some researches has been reported that sesam yield is affected by irrigation. (Mensah ., 2006) demonstrated that water limitation reduced growth and yield of sesam. (Hong ., 1985) found water deficiency in vegetative growth stage can decrease sesam yield to half due to plant height decrease. (Robinson, 1983) reported dry matter accumulation in been decreased with increasing water stress severity. (Nakagamy ., 2004) and (Ricardo ., 2008) also showed reduction of growth rate in cultural crops in drought stress conditions. (Jalilian & Mohsennia, 2013) with study on the effects of irrigation in 20, 60 and 80% F.C observed that canopy dry matter in barely depressed by stress increase and the highest dry matter was obtained in 80% F.C. (Kassab ., 2005) with investigation of moisture regims and irrigation systems on growth and yield of sesam found that yield, oil seed content, plant height and numbers of
capsule were the highest in 100% and the lowest in 60% of plant water requirement treatment. And mentioned parameters showed more reduction with deficit water increment. According to this fact that environmental conditions, especially soil moisture, affect on sesame yield, understanding relationships between plant, water consumption and developing methods based on this knowledge can be useful for receiving to maximum yield. Since sesame water requirement has not investigated sufficiently yet, the present study has been done with the aim of determining sesame response to deficit irrigation in drought conditions.

MATERIALS AND METHODS

The present study was carried out in 2012 in Agricultural Research Center of Jiroft, Iran. Jiroft is an arid and semi-arid region with precipitation mean of 170 mm. The soil texture was loamy sand with %0.17 organic matter content.

In early July (2012) seedbed preparation including ploughing, farrowing and plot forming was done and sesame seeds (C.V GL13) were sown. The experiment was based on Randomized Complete Block Design with three replications. Treatments were (I1) irrigation frequency on the basis of farmer conditions, (I2) irrigation frequency after 90 mm evaporation from pan, (I3) irrigation frequency after 120 mm evaporation from pan, (I4) irrigation frequency after 150 mm evaporation from pan, (I5) irrigation frequency after 180 mm evaporation from pan, (I6) irrigation frequency after 90 mm evaporation before flowering phase and irrigation frequency after 180 mm evaporation from pan after flowering phase, and (I7) irrigation frequency after 180 mm evaporation from pan before flowering phase and irrigation frequency after 90 mm evaporation from pan after flowering phase.

Nutritional elements application was according to the soil analysis in all treatments, equally. Cultivation was in row system with 60 cm between row and 10 cm interrow spacing. Each plot was consisted of four rows with 5 m length and distance was 120 cm and 200 cm between plots and blocks, respectively. After harvest yield, plant height, 1000 seed weight, number of capsules/plant, number of seeds per capsule, and branch numbers in plants within two internal rows were determined and row data was subjected to statistical analysis by MSTAT-C and means were separated using Duncan.

RESULTS AND DISCUSSION

From results in table 1, it is clear that irrigation frequency had significant effect on yield, capsule numbers and plant height (P≤0.01) and on 1000 seed weight and branch number/plant (P≤0.05).

Table 1. effects of irrigation frequency on yield and yield components of sesame

<table>
<thead>
<tr>
<th>S.V</th>
<th>d.f</th>
<th>Means of squares</th>
<th>Capsule/plant</th>
<th>1000 seed weight</th>
<th>Plant height</th>
<th>Branch number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>replication</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>0.003</td>
<td>48.095</td>
<td>2016</td>
<td>18.048</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Irrigation Frequency</td>
<td>6</td>
<td>0.139</td>
<td>1242.437</td>
<td>2053.1</td>
</tr>
</tbody>
</table>

*, ** significant in P≤0.05 and P≤0.01, ns: non significant

Mean comparison (by Duncan) indicated I2 resulted in the highest yield (685 kg/ha) and with increasing interval irrigation in treatment I3, I4, I5 and I6 due to deficit water, the yield reduced significantly but in treatment I7 yield and yield parameters such as plant height and branch numbers/plant promoted (table 2).

Table 2. effects of irrigation frequency treatments on yield, capsules number, 1000 seed weight, plant height and branch numbers/plant in sesame

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yield (ton/ha)</th>
<th>Capsules number</th>
<th>1000 seed weight (g)</th>
<th>Plant height (cm)</th>
<th>Branch number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (I1)</td>
<td>0.427C</td>
<td>7.7D</td>
<td>2.13C</td>
<td>127.2B</td>
<td>4.2C</td>
</tr>
<tr>
<td>I2</td>
<td>0.685A</td>
<td>88.3A</td>
<td>3.91A</td>
<td>168A</td>
<td>5.8A</td>
</tr>
<tr>
<td>I3</td>
<td>0.422C</td>
<td>56.3D</td>
<td>3.5B</td>
<td>135.3B</td>
<td>3.8C</td>
</tr>
<tr>
<td>I4</td>
<td>0.420C</td>
<td>63.3B</td>
<td>3.11C</td>
<td>135.7B</td>
<td>4.8C</td>
</tr>
<tr>
<td>I5</td>
<td>0.327D</td>
<td>44.2D</td>
<td>2.8D</td>
<td>121.5C</td>
<td>4.3C</td>
</tr>
<tr>
<td>I6</td>
<td>0.212E</td>
<td>49.8D</td>
<td>2.5E</td>
<td>128.2C</td>
<td>4C</td>
</tr>
<tr>
<td>I7</td>
<td>0.557B</td>
<td>68B</td>
<td>3.6B</td>
<td>118.8C</td>
<td>5.5AB</td>
</tr>
</tbody>
</table>

Means within the columns with the same letter don’t differ significantly at P=0.05
Although in the present study I₂ had the highest yield, in I₇ with economic use of irrigation water by 1000 m³/ha, considerable yield was produced (557 kg/ha) that according to drought circumstance, this treatment is preferred to I₂. The key point in I₇ causing significant positive effect on yield, yield parameters, plant height and branch number/plant in compare with I₃, I₄, I₅ and I₆, is this fact that flowering stage, capsule set stage and grain filling stage are the most sensitive stages to deficit water in sesame and with accessing to sufficient water in these stages, treatment I₇ promoted yield, yield components, plant height and branch number per plant (figure 1, 2, 3).

(Boutraa & Sanders, 2001) reported that drought stress reduced yield and yield components in flowering stage and grain filling stage. (Samarah, 2005) confirmed the effect of water deficiency in growth period, especially flowering and grain filling stages, on barely yield. (Zafarani moattar ., 2011) with studying different irrigation treatments and irrigation disruption at flowering stage, grain filling stage and during flowering and grain filling stages observed that dry matter content, plant growth rate and grain yield were the lowest in flowering and grain filling stages. (Mensah .,
2006) showed sesame yield and yield parameters decreased with water deficiency. (Dilip., 1991) reported that branch number, seed number per capsule and biomass significantly increased with irrigation number. (Rezvani moghaddam ., 2005) with investigation the effect of different intervals (1, 2, 3, 4 weeks) on sesame yield found that the highest grain yield was obtained at 1 week irrigation interval while the the lowest was in 4 weeks irrigation interval.

**Conclusion**

The results indicated that yield and yield components of sesame were affected by water deficiency and the yield and yield parameters decrease considerably, if plant subjected to drought stress during flowering stage and grain filling stage. But also these results showed irrigation management such as $I_7$ treatment, in addition of optimum yield production, saves about 6 million m$^3$/year irrigation water in arid condition of Jiroft.

**REFERENCES**


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