Evaluation of deficit irrigation management, nitrogen levels, and seed priming simultaneously, on some properties of hybrid sunflower (Helianthus annuus)

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Abstract
Sunflower (Helianthus annuus L.), one of the world’s leading oilseed crops, was investigated for its properties in response to deficit irrigation, nitrogen levels, and seed priming. The end points were: Biological yield, oil yield and water use efficiency (WUE). For this purpose, a randomized block experiment design with split-split plot arrangement with four replicates was established. The overall results obtained in this study indicate that different level of nitrogen, time of irrigation, seed priming and their interaction had significantly affected on biological yield and WUE (p<0.01). Also, different level of nitrogen and time of irrigation had significantly affected on biological yield (p<0.05 and p<0.01), respectively. But, seed priming and their interactions had no significant effect on this trait. Treatment of I N 3 P 3 had the most WUE (3.02 kg/m 3). Pre-treatment mono ethanol amine had the most effect on biological yield. The using of mono ethanol amine in I N 5 P 5 could prevent the decrease of biological yield (from 40.21 to 7.43 %) due to drought stress in comparison with I N 4. Investigation of project’s results shows that pre-treated sunflower plant by mono ethanol amine decrease the damages but it to be repeated by more researches for better announcement. 

Keywords: biological yield, Nitrogen, oil yield, Sunflower, Water use efficiency (WUE).

Introduction
Sunflower (Helianthus annuus L.), one of the world’s leading oilseed crops, is mainly cultivated for its oil. Non oilseed sunflower (confectionary) with lower oil content is mainly consumed in the domestic market, such as in snack or bakery foods (Goksoy et al., 2004; Kiani et al., 2007). Like most oilseeds, sunflower has a potential utility for many industries. Different products can be obtained from crude oil, cake, hulls or refined oil, including plastics, lecithin, or emulsifying agents (Taiz & Ezeiger, 1991; Aguirrezabal & Pereyra, 1998). In the last few years, sunflower oil has also gained special recognition based on non-food purposes. Its use as biodiesel, or as vegetable-oil based fuel for many vehicles, including farming equipment is feasible (Pereyra-Irujo et al., 2009). Genetic improvement and the emergence of new industrial processes make it possible to implement these potential uses. Most of the oil is accumulated in the kernel (shelled seed) and only 3-5% is located in the pericap, also known as “hull” (Connor & Sadras, 1992). The oil concentration is determined by genetic factors, but it can be modified by the environment and growth conditions. Usually, black hull hybrids produce fruit (seeds) with an oil concentration higher than striped hull hybrids (Izquierdo et al., 2008). It is common to find mixture of hybrids (seeds of black and striped hull) as feeding in the dehulling process. In order to improve equipment handling and to optimize oil yield, it would be necessary to know the differential characteristics of these hybrids. A few reports on moisture-dependent physical properties of sunflower seeds have been published. Gupta and Das (1997) analyzed the physical properties of a sunflower variety grown in India (Morden) (Gupta & Das, 1997), (Santalla & Mascheroni 2003) studied a striated high oleic sunflower hybrid cultivated in Argentina, but no bibliography has been found about a comparison among sunflower hybrids of different structural characteristics (Santalla & Mascheroni, 2003). Irrigation is one of the most important limiting factors of the agricultural production during the hot and dry periods (Dagdelen et al., 2006). Sunflower oil contains large amount of A, D, E, K vitamins and considerable proteins (20-40%) (Connor & Hall, 1997; Aerts & Chapin, 2000). By fertilizing and increasing the soil fertility, the seed yield and its oil content are increased (Egli, 1998; Sudhaker et al., 2003; Sharma et al., 2002). Simultaneous decrease of oil percentage and increase of nitrogen levels have been reported by many researchers (Tomar et al., 1997; Janssen, 1998). The present study aims for evaluation on deficit irrigation, nitrogen levels, and seed priming simultaneously for hybrid sunflower (Helianthus annuus). The properties evaluated were: Biological yield, oil yield and Water use efficiency (WUE).

Materials and methods
A randomized block experiment design with split-split plot arrangement with four replicates was established in
the research farm of the Islamic Azad University, Varamin-Pishva branch, Tehran, Iran. Each plot included 7 planting lines (distance between lines was 60 cm), length of each line was 2 m and also distance in-row was 20 cm. The soil was classified in loam-clay. After soil experiment, seeds were planted in two depths include 0-30 cm and 30-60 cm as furrow method and then were irrigated immediately. Protections were achieved accordance routine agronomic methods. All treatments were irrigated three times in order to homozygous germination and the used water was calculated by contour during the growth season. In

Table 1. Characteristics of irrigation treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No. of irrigation</th>
<th>Used water (m³/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I₁</td>
<td>13</td>
<td>8563.492</td>
</tr>
<tr>
<td>I₂</td>
<td>11</td>
<td>7246.031</td>
</tr>
<tr>
<td>I₃</td>
<td>11</td>
<td>7246.371</td>
</tr>
<tr>
<td>I₄</td>
<td>9</td>
<td>5928.571</td>
</tr>
</tbody>
</table>

order to calculation of irrigation depth, soil samples selected from depths 0-30 and 30-60 cm. the humidity percentage of soil was calculated and then the needed water to reach to field capacity was measured. Also soil

was fertilized with nitrogen fertilizer in two times include pre-planting (1/3) and post-thinning (2/3). Experimental treatments include irrigation levels in four levels:

I₁: perfect irrigation, I₂: no irrigation from budding to flowering, I₃: no irrigation from flowering to grain filling and I₄: no irrigation from budding to grain filling stage as main factor (drought stress in phonological stages of plant) and used nitrogen in three levels of 0, 90 and 180 kg/ha as marginal factor. Seed priming in three levels of Pt₁: no pre-treatment, Pt₂: soaking seeds in distilled water for 24 hours and Pt₃: soaking seeds in mono ethanol amine for 6 hours as sub-factor.

Wind speed (km/hr) Evaporation (mm) rainfall (mm) RH (%) Sun hours (Hour) Min mean temperature (°C) Max mean temperature (°C) Annual mean temperature (°C) factors
<table>
<thead>
<tr>
<th>Wind speed (km/hr)</th>
<th>Evaporation (mm)</th>
<th>rainfall (mm)</th>
<th>RH (%)</th>
<th>Sun hours (Hour)</th>
<th>Min mean temperature (°C)</th>
<th>Max mean temperature (°C)</th>
<th>Annual mean temperature (°C)</th>
<th>factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.16</td>
<td>292.16</td>
<td>1.13</td>
<td>33.16</td>
<td>318.66</td>
<td>18.35</td>
<td>34.63</td>
<td>26.5</td>
<td>mean</td>
</tr>
</tbody>
</table>

Grain oil yield is one of the most important traits in sunflower (grain oil yield= grain oil percentage * grain yield). Obtained results from Table 3 show that different level of nitrogen and time of irrigation had significantly affected on oil yield with confidence interval of 95% and 99% (P≤0.05 and P≤0.01), respectively. But, seed priming and their interactions had no significant effect on this trait. The maximum and minimum amount of oil yield (2003 and 713.51 kg/ha) achieved in I₁N₁Pt₁ and I₃N₃Pt₃ treatments, respectively. Oil yield in I₂ increased 5.46% toward I₁. Also, minimum and maximum amount of oil yield achieved in 0 and 180 kg N/ha.

Water use efficiency (WUE)

According to Table 3, different level of nitrogen, time of irrigation, seed priming and their interaction had significantly affected on WUE with confidence interval of 99% (P≤0.01). The maximum WUE were obtained in I₃N₃Pt₃ (3.02 kg/m³), I₁N₃Pt₃ (2.80 kg/m³) and I₃N₃Pt₃ (2.78 kg/m³) whereas, the lowest WUE (1.18 kg/m³) have been reported in I₁N₁Pt₁ (Table 4).

Conclusion

The overall results obtained in this study indicate that different level of nitrogen, time of irrigation, seed priming and their interaction had significantly affected on biological yield and WUE with confidence interval of 99%
had the most WUE (3.02 kg/m²). Pre-treatment mono ethanol amine had the most effect on biological yield. The using of mono ethanol amine in I₄P₃ could prevent the decrease of biological yield (from 40.21 to 7.43 %) due to drought stress in comparison with I₄P₃. Investigation of p0project’s results shows that pre-treated sunflower plant by mono ethanol amine decrease the damages but it to be repeated by more researches for better announcement.

References