EFFECT OF IRRIGATION LEVELS ON MAIZE YIELD PLANTED UNDER CLIMATIC CONDITIONS OF WASIT PROVINCE

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Abstract

This study was carried out to determine the effects of different irrigation levels on yield and yield components of maize planted at basin irrigation method under climatic conditions of Middle Iraq. Irrigation water was applied as 125%, 100%, 75% and 50% of evaporation from a Class A Pan (Ep). The experimental layout was distributed in randomized complete block design (RCBD) with three replicates. Irrigation levels significantly affected yield and yield contributing parameters at P<0.05 level. The highest grain yield and yield components were found at 125% and 100% Ep while the lowest were found at 50% Ep treatment. Irrigation levels had statistically significant effect on dry above ground biomass production of maize at P<0.05 level.

Key words: Irrigation levels, Ep%, yield and yield components of maize.

Introduction

Water is an important natural resource and its increasing scarcity has led to concerns for its efficient use, management, and sustainability (Brar et al., 2016). Water shortage is one of the main constraints for economic development in arid and semi-arid areas. However, it is very important for these areas to promote public awareness as regards water-saving measures so as to develop the social sustainability and extension of new cultivated areas (El-Hendawy et al., 2008).

Water is one of the most important factors affecting crop production and its movement through the soil-plant atmosphere (Hussain et al., 2015). One of the most important factors that can limit crop production is the availability of water (Farsiani et al., 2011).

Deficit irrigation provides means of reducing water consumption while minimizing adverse effects on yield (Abd el-wahed et al., 2015). The irrigation studies have made great achievements on improving the efficiency of water and ensuring food security, but still has great potential for improving water use efficiency in many field crops (Al-Maeini et al., 2018).

Due to the serious water shortages, the great challenge for the coming decades is the task of increasing food production with less water, particularly in countries with limited water, land resources. Therefore, techniques are needed to increase the water use efficiency (Tariq and Usman, 2009).

Water scarcity and drought are the major factors constraining agricultural crop production in arid and semi-arid zones of the world. Irrigation is today the primary consumer of fresh water on earth (Yazar et al., 2009).

Kuscu et al., (2013) indicated that there was linear relationship between grain yield of maize and seasonal irrigation water amount. Maize (Zea mays L.) is the third most important cereal crop in the world after wheat and rice (Al-Maeini and Kadim, 2018).

The objectives of this study were to evaluate the effects of four irrigation levels on yield and it is components of maize planted in middle Iraq.

Materials and methods

Experimental site

The research was conducted in the central Kut nursery, Wasit Agriculture Directorate during the season 2018 under ecological and climatical conditions of Kut district, Wasit Province, Iraq. Soil samples were taken from depths of 0 – 40 cm prior to sowing of crop and
analyzed to determine the physical and chemical properties which are shown in Table 1 by using methods of soil analysis (Page et al., 1982).

Table 1: Some chemical and physical properties of soil field experiment (depth 0-40 cm) for the season 2018.

<table>
<thead>
<tr>
<th>Measured Character</th>
<th>Value</th>
<th>measuring unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.8</td>
<td></td>
</tr>
<tr>
<td>Electrical conductivity (EC)</td>
<td>4.4</td>
<td>dS m⁻¹</td>
</tr>
<tr>
<td>Available Nitrogen</td>
<td>15</td>
<td>mg kg⁻¹</td>
</tr>
<tr>
<td>Available Phosphorus</td>
<td>53</td>
<td>mg kg⁻¹</td>
</tr>
<tr>
<td>Available Potassium</td>
<td>189</td>
<td>mg kg⁻¹</td>
</tr>
<tr>
<td>Soil texture</td>
<td>clay</td>
<td></td>
</tr>
</tbody>
</table>

Experimental design and treatments

The experiments were conducted using a randomized complete block design with three replications, the area of each plot was 6 m². The irrigation treatments considered in the study were basin irrigation equivalent to different level of 50% (I₁), 75% (I₂), 100% (I₃) and 125% (I₄) of evaporation from a Class A Pan.

Planting and fertilization

Hybrid maize (Kalimeras) was used and the seeds were sown at 5 August 2018, at a spacing of 25 cm × 75 cm. All treatments plots received the same amount of fertilizer application at rates of 300 kg ha⁻¹ DAP (Di Amino Phosphate, 18:46:0), and applied uniformly before planting, 320 kg ha⁻¹ of urea (46% N), was applied in banding along the rows on two doses, first it was applied at six leaves appears and second after 30 days of applying them.

Pest control weed was carried out as needed. Five plants in the middle rows in each experimental unit were harvested at physiological maturity at 20 November in 2018. Some biological properties were study and the plants were dried, at 65°C until constant weight. The number of row per ear, number of grains per row, number of grains per ear, 500-grain weight, grain yield, biological yield and harvest index was investigated.

Statistical analysis:

All collected data in this study were analyzed using analysis of variance (ANOVA). Mean separation of treatment effects in this study was accomplished using least significant difference (LSD) test at probability levels of 0.05.

Results and Discussion

Effect of irrigation levels on some biological parameter were shown in Table 2. The results showed that the number of rows per ear of maize was not affected by irrigation levels. On the other hand the irrigation levels significant effect on the number of grains per row (Table 2). The highest average of the no. of grains per row (35.83) was the I₄ level, while the lowest average (29.33) was found at the I₁ level. These results were in agreement with (Karasu et al., 2015), who stated that the water stress decreased the number of grain per row at silking stage.

The results in Table 2 showed that irrigation levels affected the number of grains per ear significantly. Maximum no. of grains per ear (514.2) was obtained when irrigation was applied at 125% Ep. While minimum no. of grains per ear (387.5) at 50% Ep. These results were in agreement with (Bozkurt et al., 2011) and (Karasu et al., 2015). Number of grains per ear decreased with increasing deficiency in irrigation water, and number of grains is closely associated with yield of maize and the number of grains per ear is a yield component that varies markedly with stress water (Tabatabaei and Dadashi, 2013).

The results in Table 2 showed the effect of irrigation levels under basin irrigation method on 500-grain weight of maize crop. The results indicated that the highest 500 grain weight value was (188.8g) observed using 125% Ep. While, the lowest value was (156g) obtained with 50% Ep. Similar results were reported by (Bozkurt et al., 2011) and (Xiukang et al., 2014). Because, when the amount of water decreased, the 500-grain weight were decreased (Karasu et al., 2015).

The effect of irrigation levels on average grain yield, biological yield and harvest index of maize crops were shown in Table 3. The results indicated that the grain yield was affected significantly by various irrigation levels. Maximum grain yield (9.603 t ha⁻¹) was obtained when irrigation levels was applied at 125% Ep. While minimum grain yield (6.437 t ha⁻¹) at 50% Ep. Xiukang et al., (2014) reported that a linear relationship existed between seasonal water use and grain yield, also the declines in dry matter and grain yields could be attributed to an increased soil water deficit. These results are in line with, (Bozkurt et al., 2011) and (Karasu et al., 2015).

Biological yield affected significantly by irrigation levels. Maximum biological yield (25.80 t ha⁻¹) was obtained when irrigation levels treatments applied at 125% Ep (Table 2). Minimum biological yield (20.29 t ha⁻¹) was observed at I₁ level. (Tabatabaei and Dadashi, 2013) indicated that the effect of irrigation levels on biological yield was significant, that water deficiency in seed filling stage results in dry matter accumulation decrease and simultaneously shorten seed improvement period. These results are in agreement with those of (Bozkurt et al.,
Table 2: Effect of irrigation levels on the average No. of rows per ear, No. of grains per row, No. of grains per ear and 500 grain weight of maize during the season 2018.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>No. of rows per ear</th>
<th>No. of grains per row</th>
<th>No. of grains per ear</th>
<th>500 grain weight (gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1</td>
<td>13.20</td>
<td>29.33</td>
<td>387.5</td>
<td>156.0</td>
</tr>
<tr>
<td>I2</td>
<td>13.83</td>
<td>31.67</td>
<td>437.3</td>
<td>172.7</td>
</tr>
<tr>
<td>I3</td>
<td>14.37</td>
<td>34.50</td>
<td>500.3</td>
<td>182.2</td>
</tr>
<tr>
<td>I4</td>
<td>14.40</td>
<td>35.83</td>
<td>514.2</td>
<td>188.8</td>
</tr>
<tr>
<td>LSD(0.05)</td>
<td>N.S</td>
<td>4.492</td>
<td>8.068</td>
<td>1.061</td>
</tr>
</tbody>
</table>

2011) and (Xiukang et al., 2014).

Data in Table 3 indicated that the highest harvest index value (37.58) was obtained under basin irrigation method using 125% Ep, the lowest value was (32.13) with 50% Ep. This result are consistent with findings of (Bozkurt et al., 2011), who reported that the irrigation treatments had significant effect (P<0.01) on harvest index.

Table 3: Effect of irrigation levels, on the average grain yield, biological yield and harvest index of maize during the season 2018.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Grain yield (t ha⁻¹)</th>
<th>Biological yield (t ha⁻¹)</th>
<th>Harvest index</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1</td>
<td>6.437</td>
<td>20.29</td>
<td>32.13</td>
</tr>
<tr>
<td>I2</td>
<td>8.068</td>
<td>22.72</td>
<td>36.07</td>
</tr>
<tr>
<td>I3</td>
<td>9.417</td>
<td>24.76</td>
<td>38.23</td>
</tr>
<tr>
<td>I4</td>
<td>9.603</td>
<td>25.80</td>
<td>37.58</td>
</tr>
<tr>
<td>LSD(0.05)</td>
<td>1.061</td>
<td>2.316</td>
<td>3.321</td>
</tr>
</tbody>
</table>

Conclusion

From the above mentioned presentation, it can be concluded that:

1- The effects of irrigation levels on yield and yield components of maize plant were significant in this study, the highest grain yield was obtained from 125% and 100% Epan treatment as about (9.603 and 9.417 t ha⁻¹) while the lowest ones were observed in irrigation treatment 50% Epan as about (6.437 t ha⁻¹).

2- Applied irrigation water was linearly and positively related to the duration of reproductive phase and to the grain yield. Higher dry matter accumulation and longer reproductive phase under well irrigation levels led to significantly higher grain yield.

3- The grain yield and biological yield were significantly and positively affected by irrigation levels. The highest GY and BY values were obtained from plants irrigated with the 125% and 100% Epan. Meanwhile, the lowest values were recorded when plants were irrigated with 50% Epan treatment under ecological conditions of middle region, Iraq.

References


Madison, Wisconsin, USA.