Irrigation Management Strategies in Corn Production under Various Water Qualities

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Abstract: The experiment was conducted to test various irrigation patterns for maximum yield at Sindh Agriculture University, Tando Jam, during the year 1999. All the cultural practices were adopted to maintain the area free from weeds and insect pests. The results of the experiment showed the superiority of irrigation pattern where canal water (ECe 0.5 to 1.00 dS/cm) was applied followed by those irrigation patterns where canal irrigation water was used in two growth stages which recorded highest values of plant stand, plant height, cob length, cob diameter, cob number, seed index, dry forage and grain yield. The lowest growth and yield contributing parameter values were exhibited in those irrigation patterns where pumped saline water (ECe 1.26 to 1.50 dS/cm) was used during the growing period or pumped saline water was applied in two growing stages of the corn crop. Based on the results it is recommended that canal water should be used during the growing period. But, if there is scarcity of canal water then pumped saline water could be used in one growth stage and canal water in other growth stages.

Keywords: Corn, yield, irrigation, water qualities

Introduction
The world irrigated land is estimated to be 224 million hectares, only 20 million hectares are considered as saline soil (Doorenbos and Pruitt, 1982). Soil salinity is still a major problem even in the highly developed countries. In California for example, the total losses from salinization in San John basin was about 30 million dollars annually (Abdulattif, 1993).
Irrigated agriculture faces the need to produce more food and fiber, in a sustainable manner, with lower quality irrigation water (Bouwrier, 1997). There is considerable farmer experience with the use of poor quality water for irrigation (Oster, 1984a). Extensive research information exists about water quality effects on plants and soils (Rhoades et al., 1992; Summer and Naiedu, 1998; Tani, 1998) and about the negative environmental impacts on local and interregional surface and ground water (Oster, 1984b; Westcot, 1988). Depending on local geological conditions, ecological impacts can involved toxic effect of trace elements on wildlife, in addition to those generated by increased salinity (National Research Council, 1989) on downstream water users, and on ground water quality, these impacts require purposeful planning (Van Schilfgaarde, 1994).
The decrease of water resources in the country confirms the idea of searching for new resources such as using saline water in irrigation. This process as many difficulties because of direct or/and indirect effect of saline water on physical, chemical and biological properties of the soil and plant. Many situations exits where saline ground water or agricultural drainage water could be used for irrigation, if the water is readily accessible and available. However, such use should be taken only if long term deleterious effects on soil properties can be avoided (Glani Abdelgawad and Abdelrahaman Ghabbaj, 1999). Many scientists Abeldigawad (1995), and Rhoades (1987), have concluded the use of saline water for irrigation was feasible, especially when saline water are blended with good quality water or alternated. Also in case where rainfall is greater than 200 mm. (Abdalgawad, 1995) and drainage conditions of soil are adequate. Further, it was observed that the scarcity of water has forced farmers to extensively explore the possibility of using brackish water for irrigation of agricultural crops (Oron, 1993). This study aims to prepare farmer’s guide for quality of irrigation water for achieving maximum production of corn crop.

Materials and Methods
The field experiment was laid out at Sindh Agriculture University, Tando Jam, Pakistan, in RCBD with four replications in net plot size 5.61 x 3.87 m. The irrigation patterns based on canal irrigation (ECe 0.6 to 1.00 dS/cm) and pumped saline water (ECe 1.26 to 1.50 dS/cm) applied at three crop growth stages. The description of irrigation patterns is as under:

I1 = Irrigation by canal water during the vegetative stage
I2 = Irrigation by canal water during the maturity stage
I3 = Irrigation by canal water during the vegetative and maturity stages
I4 = Irrigation by canal water during the vegetative stage and by canal water reproductive and maturity stages
I5 = Irrigation by canal water during the vegetative and maturity stages and by pumped saline water during the reproductive stage
I6 = Irrigation by pumped saline water during the vegetative and maturity stages and by canal water during the reproductive stage
I7 = Irrigation by pumped saline water during the vegetative and reproductive stages and by canal water during maturity stage
I8 = Irrigation by pumped saline water during the growing period

Description of eight irrigation patterns

<table>
<thead>
<tr>
<th>Growth stages</th>
<th>Irrigation patterns</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1</td>
<td>I2</td>
</tr>
<tr>
<td>Vegetative</td>
<td>X</td>
</tr>
<tr>
<td>Reproductive</td>
<td>X</td>
</tr>
<tr>
<td>Maturity</td>
<td>O</td>
</tr>
</tbody>
</table>

X = Irrigation by canal water (ECe 0.6 to 1.00 dS/cm),
Q = Irrigation by pumped saline water (ECe 1.26 to 1.50 dS/cm)

Specification of seeds, planting and cultural practices: Seeds of Cargill variety were drilled in well prepared moist soil at 20 and 30 cm plant and row spacing. The canal irrigation was applied until the plants germinated. First application of N (20 kg ha⁻¹) was done during first irrigation, then 40 kg ha⁻¹ was incorporated at tilling initiation. However, whole of P (60 kg ha⁻¹) was applied at the time of planting. Thinning, weeding, insect/pest control, and care activities were performed when ever necessary. Soil samples for water use determination were taken on gravimetric method before irrigation application and water was applied to reach field capacity.

Results and Discussion
Experimental results on irrigation patterns applied to corn crop
Table 1: Plant characters as affected by various irrigation patterns

<table>
<thead>
<tr>
<th>Irrigation Patterns</th>
<th>Plant/plant height (cm)</th>
<th>Plant height (cm)</th>
<th>Cob diameter (cm)</th>
<th>Cob length (cm)</th>
<th>No. of cobs/plant</th>
<th>No. of unfilled cobs/plant</th>
<th>Seed index yield/plant (g)</th>
<th>Dry forage yield/plant (kg)</th>
<th>Dry forage yield (kg/ha)</th>
<th>Grain yield (Kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I₁</td>
<td>191.5±1</td>
<td>14.1±1</td>
<td>6.1±0</td>
<td>56.0±0</td>
<td>6.25</td>
<td>252.1±2</td>
<td>17.8±3</td>
<td>2972.5±0.0</td>
<td>3.4±0</td>
<td>578.0±0</td>
</tr>
<tr>
<td>I₂</td>
<td>191.0±0</td>
<td>13.0±0</td>
<td>6.1±0</td>
<td>56.0±0</td>
<td>6.25</td>
<td>241.3±0</td>
<td>17.0±0</td>
<td>2834.0±0.0</td>
<td>2.8±0</td>
<td>475.0±0</td>
</tr>
<tr>
<td>I₃</td>
<td>191.5±1</td>
<td>12.8±1</td>
<td>6.1±0</td>
<td>56.0±0</td>
<td>6.25</td>
<td>231.0±1</td>
<td>16.4±0</td>
<td>2743.0±0.0</td>
<td>2.4±0</td>
<td>400.0±0</td>
</tr>
<tr>
<td>I₄</td>
<td>191.0±0</td>
<td>12.8±1</td>
<td>6.1±0</td>
<td>56.0±0</td>
<td>6.25</td>
<td>234.0±0</td>
<td>17.2±0</td>
<td>2870.0±0.0</td>
<td>2.8±0</td>
<td>430.0±0</td>
</tr>
<tr>
<td>I₅</td>
<td>191.5±1</td>
<td>12.8±1</td>
<td>6.1±0</td>
<td>56.0±0</td>
<td>6.25</td>
<td>218.0±0</td>
<td>14.9±0</td>
<td>2443.0±0.0</td>
<td>2.7±0</td>
<td>456.0±0</td>
</tr>
<tr>
<td>I₆</td>
<td>191.0±0</td>
<td>12.8±1</td>
<td>6.1±0</td>
<td>56.0±0</td>
<td>6.25</td>
<td>207.0±0</td>
<td>14.1±0</td>
<td>2353.0±0.0</td>
<td>2.1±0</td>
<td>380.0±0</td>
</tr>
<tr>
<td>I₇</td>
<td>191.5±1</td>
<td>12.8±1</td>
<td>6.1±0</td>
<td>56.0±0</td>
<td>6.25</td>
<td>204.7±1</td>
<td>13.6±1</td>
<td>2230.0±0.0</td>
<td>2.0±0</td>
<td>335.0±0</td>
</tr>
<tr>
<td>I₈</td>
<td>191.0±0</td>
<td>12.8±1</td>
<td>6.1±0</td>
<td>56.0±0</td>
<td>6.25</td>
<td>201.0±0</td>
<td>13.1±0</td>
<td>2130.0±0.0</td>
<td>2.0±0</td>
<td>306.0±0</td>
</tr>
<tr>
<td>Mean</td>
<td>169.0±0</td>
<td>12.8±1</td>
<td>6.1±0</td>
<td>56.0±0</td>
<td>6.25</td>
<td>224.0±0</td>
<td>13.6±1</td>
<td>2572.0±0.0</td>
<td>2.5±0</td>
<td>420.0±0</td>
</tr>
<tr>
<td>LSD(5%)</td>
<td>0.965</td>
<td>0.23</td>
<td>0.13</td>
<td>0.04</td>
<td>0.28</td>
<td>4.439</td>
<td>0.293</td>
<td>287.3±0.0</td>
<td>0.20±0</td>
<td>193.3±0</td>
</tr>
<tr>
<td>LSD(1%)</td>
<td>1.779</td>
<td>0.34</td>
<td>0.68</td>
<td>1.20</td>
<td>0.76</td>
<td>8.881</td>
<td>1.11±1</td>
<td>527.2±0.0</td>
<td>2.7±0</td>
<td>287.2±0</td>
</tr>
</tbody>
</table>

Mean marked with same letter superscripts are not significantly different at 5% level of significance by DMRT.

exhibited maximum number (183) of plants/pot in plots which received canal water during the growing period (I₂), followed by I₁. However, minimum number of plants/pot were recorded in I₈ where plots received pumped water during growing period or in I₁, I₂ and I₃ where canal water was applied in conjunction with pumped saline water.

The similar trend of recording tall plants (191.5±1 cm), lengthy huskied cobs (14.1±1 cm), maximum cob number/pot (58.00), less number of unfilled cobs/pot (6.25), more seed index (1000 grain weight) (252.1±2 grams), dry forage yield (17.8±3 kg/pot, 2972.5±0 kg/ha), and superior grain yield (5.46 kg/pot and 6.78 kg/ha) was observed in plots where canal water was applied to the corn crop during whole growing period.

The overall results revealed that higher values were obtained in plots which were irrigated with canal water throughout the growing period, followed by those plots which received canal water in two corn growth stages. The minimum data were recorded for all crop parameters where crop received saline pumped water, followed by those irrigation patterns where saline pumped water was combined with well water and applied at two growth phases. London (1964) also pointed out that grain yield potential of corn increased when it was irrigated with canal water compared with a higher ECe water.

The experimental results also revealed that reproductive and maturity, crop growth stages were more sensitive to saline waters in comparison to vegetative phase. Gupta (1979), also found that even if a plant could be grown under irrigation its yield may thereby be affected by quality water.

Recommendations

- Canal water is better approach to gain maximum yield and improve soil fertility. But, if the availability is scare in any crop growth phase the saline pumped water can be used for plant growth and development. The present studies recommend that use of irrigation patterns I₁, I₂, and I₃, because of best corn yields.

References