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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 1.25 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.

Key words: 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, 1992). 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 (Abdulsattar, 1999).

Irrigated agriculture faces the need to produce more food and fiber, in a sustainable manner, with poorer quality irrigation water (Bouwer, 1997).There is considerable farmer experience with the use of poor quality water for irrigation (Oster, 1994a). Extensive research information exists about water quality effects on plants and soils (Rhoades *et al.*, 1992; Summer and Naidu, 1998; Tanji, 1990) and about the negative environmental impacts on local and interregional surface and ground water (Oster, 1994b; 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 (Gilani Abdelgawad and Abdelrahman Ghaibah, 1999). Many scientists Abdelgawad (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. (Abdelgawad, 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 5.81 x 3.87 m. The irrigation patterns based on canal irrigation (ECe 0.5 to 1.00 dS/cm) and pumped saline water (ECe 1.25 to 1.50 dS/cm) applied at three crop growth stages. The description of irrigation patterns is as under:

- I_1 = Irrigation by canal water during the growing period
- I_2 = Irrigation by canal water during the vegetative and reproductive stages and by pumped saline water during the maturity stage.
- I_3 = Irrigation by canal water during the vegetative and maturity stages and pumped saline water during the reproductive stage.
- I_4 = Irrigation by pumped saline water during the vegetative stage and by canal water reproductive and maturity stages.
- I_5 = Irrigation by canal water during the vegetative stage and by pumped saline water during the reproductive and maturity stages.
- I_6 = Irrigation by pumped saline water during the vegetative and maturity stages and by canal water during the reproductive stage.
- I_7 = Irrigation by pumped saline water during the vegetative and reproductive stages and by canal water during maturity stage.
- I_8 = Irrigation by pumped saline water during the growing period.

Description of eight irrigation patterns

Growth stages	Irrigation patterns							
	I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8
Vegetative	X	X	X	Q_i	X	Q_i	Q_i	Q_i
Reproductive	X	X	Q_i	X	Q_i	X	Q_i	Q_i
Maturity	X	Q_i	X	X	Q_i	Q_i	X	Q_i

X = Irrigation by canal water (ECe 0.5 to 1.00 dS/cm).
Q_i = Irrigation by pumped saline water (ECe 1.5 to 1.50 dS/cm).

Specification of seeds, planting and cultural practices: Seeds of Cargil maize 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, remaining 40 kg ha^{-1} was incorporated at tussling 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 irrigatbn application and water was applied to reach field capacity.

Results and Discussion

Experimental results on irrigation pattens applied to corn crop

Table 1: Plant characters as affected by various irrigation patterns

Irrigation Patterns (I)	Plant/ plot	Plant height (cm)	Cob length (cm)	Cob diameter (cm)	No.of cobs/ plot	No.of unfilled cobs/plot	Seed index (cm)	Dry forage yield/plot	Dry forage yield	Grain yield/ plot (kg)	Grain yield (Kg ha^{-1})
I_1	63.00a	191.51a	14.18a	6.10a	58.00a	6.25d	252.12a	17.83a	29725.00a	3.46a	5780.00a
I_2	60.00b	181.07c	13.04b	5.75a	51.00c	9.25c	241.13b	17.06b	28438.00b	2.85b	4750.00b
I_3	55.00c	171.56d	12.88c	5.50a	48.52d	9.25c	227.90c	16.48c	27472.00c	2.40c	4000.00d
I_4	61.00d	183.80b	13.19b	5.88a	54.25b	6.75d	243.60b	17.22b	28708..00b	2.89b	4830.00b
I_5	53.50e	165.20e	12.43c	5.30a	48.00d	9.25c	218.05d	14.90d	24438.00d	2.73b	4563.00c
I_6	52.00e	162.57f	12.26cd	5.09a	45.50e	10.50b	207.90e	14.15e	23592.00e	2.16d	3605.00e
I_7	52.50e	160.94g	11.63d	5.78a	44.25e	11.00ab	204.17ef	13.62f	22708.00f	2.01d	3358.00e
I_8	51.25e	142.53g	11.27de	4.69a	42.25f	11.75a	197.15f	13.61f	22697.00f	2.02d	3357.00e
Mean	56.03	169.90	12.61	5.51	48.98	9.25	224.00	15.61	25972.25	2.56	4280.38
LSD(5%)	0.965	1.307	0.25	0.513	0.884	0.526	4.439	0.283	287..33	0.209	193.36
LSD(1%)	1.779	0.34	0.698	1.204	0.716	6.062	0.385	311.23	0.284	257.28	

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

exhibited maximum number (63) of plants/pot in plots which received canal water during the growing period (I_1), followed by I_4. However, minimum number of plants/plot were recorded in I_8 where plots received pumped water during growing period or in I_7, I_6, I_5 and I_3 where canal water was applied in conjugation with pumped saline water.

The similar trend of recording tall plants (191.51 cm), lengthy husked cobs (14.18 cm), maximum cob number/plot (58.00), less number of unfilled cobs/plot (6.25), more seed index (1000 grain weight) (252.12 grams), dry forage yield (17.83 kg/plot, 29725 kg ha^{-1}), and superior grain yield (3.46 kg/plot and 5780 kg ha^{-1}) was observed in plots where canal water was applied to the corn crop during whole growing period. The overall results reveals 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 (1984) 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 phases 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 presents study recommends that use of irrigation patterns I_4 and I_2, because of best corn yields.

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