10th International Drainage Workshop of ICID
Helsinki, Finland | Tallinn, Estonia
July 6th-11th 2008

ICID-CIID

Subirrigation System to Improve Drainage water Quality in IRAN

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Introduction

- Drainage is a necessity in Arid and Semi arid regions
- High potential of nutrient leaching in drainage systems
- Excessive nutrient loading to streams and lakes deteriorate environment (aquatic ecosystems, downstream water quality, etc)

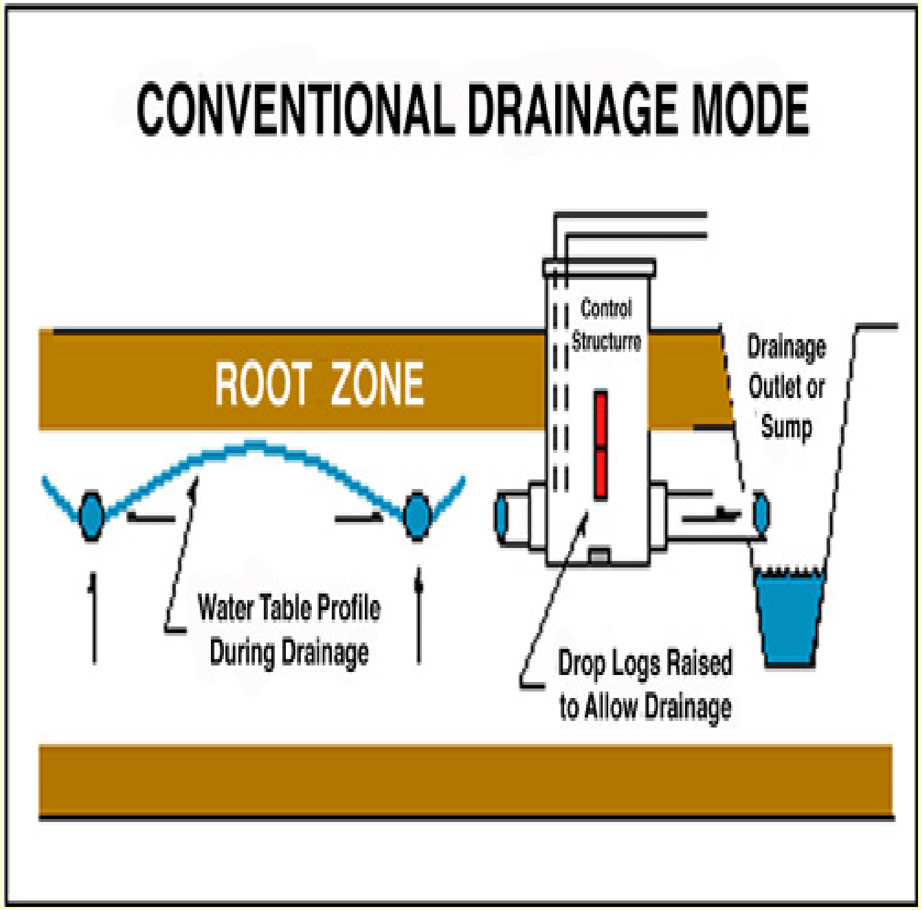
Introduction

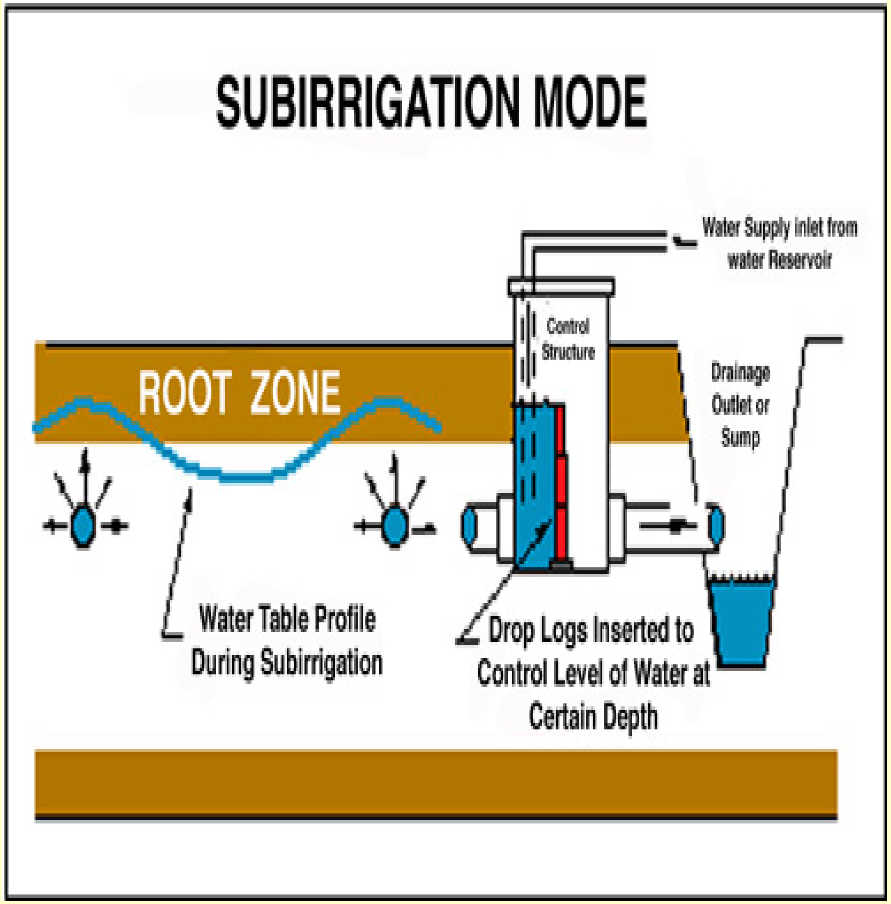
- Water pollution is both hazardous and costly
- Not necessarily only in agricultural sector.

- It is essential to apply strategies and approaches that employ simultaneous management of soil, water and crop.

- Water Table Management has been identified as one of the best management practices. In this practice, water table level is adjusted and controlled by drainage and subirrigation systems.

Water table management modes:





Introduction

- Controlled drainage restricts flow at the outlet by means of a control device, while subirrigation pumps water into the drain laterals to keep water table at a certain level. In both systems, a shallow water table is created which fulfils crop water requirement.

- Most of the research works on WTM have been conducted in humid and semi-humid areas, and limited work has been done in arid and semi-arid regions.

Introduction

- Application of sub-irrigation and controlled drainage systems in arid and semi-arid regions of Iran like Khoozestan province in south and Moghan region in northwest of Iran is justified because of the presence of an impermeable hard pan close to soil surface in addition to availability of adequate irrigation water sources.
- Presence of huge amounts of free drainage water from the existing irrigation and drainage networks is one of the major environmental problems in these regions which could significantly be moderated by application of controlled drainage and sub-irrigation systems

Objective of study:

- The objective of this study is to investigate the effect of water table management on
  - crop yield
  - draining water quality

Material and methods

- This study was carried out on an experimental field, located at the Soil and Water Research Center of University of Tehran.

- in 12 large lysimeters,

- Each lysimeter was equipped with a drain pipe installed at 100 cm depth below the soil surface.

- The field and lysimeters were planted with an annual alfalfa crop.

Material and methods

- A completely randomized design including four treatments and three replicates was used in this study.
- Water table levels were kept at 30 (SI30), 50 (SI50) and 70 cm (SI70) below the soil surface for subirrigation systems and 100 cm or more by FD-treatment .
- Except for tdhe water table management and control of water table level to assess its effects on crop yield, drainage water quality and soil salinity profile, all other agricultural practices were applied the same to all treatments.

Material and methods

Soil type and crop and irrigation water characteristic:

Soil type	Crop			Irrigation water
	type	Root depth	Salinity threshold	
Clay loam silt	annual alfalfa	30 cm	4 (dS/m)	well water EC= 1.5 (dS/m)

Material and methods

- In free drainage lysimeters Irrigation water was applied on the soil surface based on soil moisture deficit
- in subirrigation treatments through the drain pipes in order to keep water level at 30, 50 and 70 cm below the soil surface.
- Soil moisture content was monitored at different soil depths up to 60 cm depth.
- Soil salinity was measured between irrigation events at different depths.

Material and methods

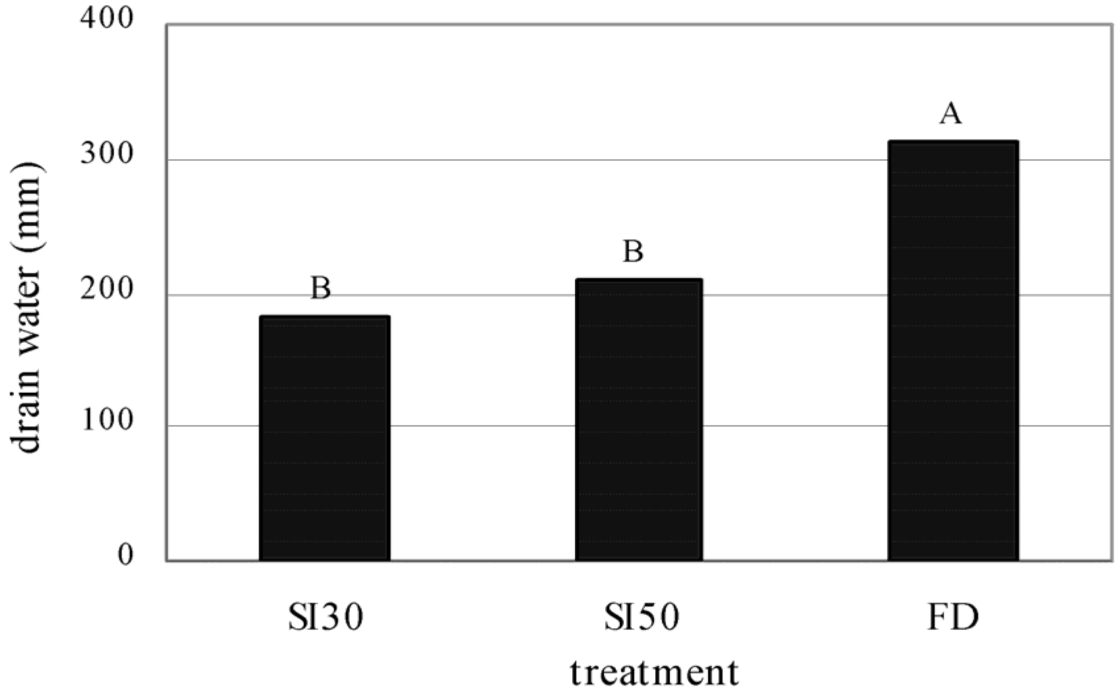
- Volume, EC, nitrate, phosphorus concentrations of drainage water and, irrigation water use and crop yield were measured for all treatments.

- In SI treatments, leaching requirements was estimated based on average ECe of the soil at root zone and it was applied whenever the soil salinity of the soil within the root zone was close to the threshold value.

- Statistical F-test method was used for comparison and evaluation of results for different treatments.

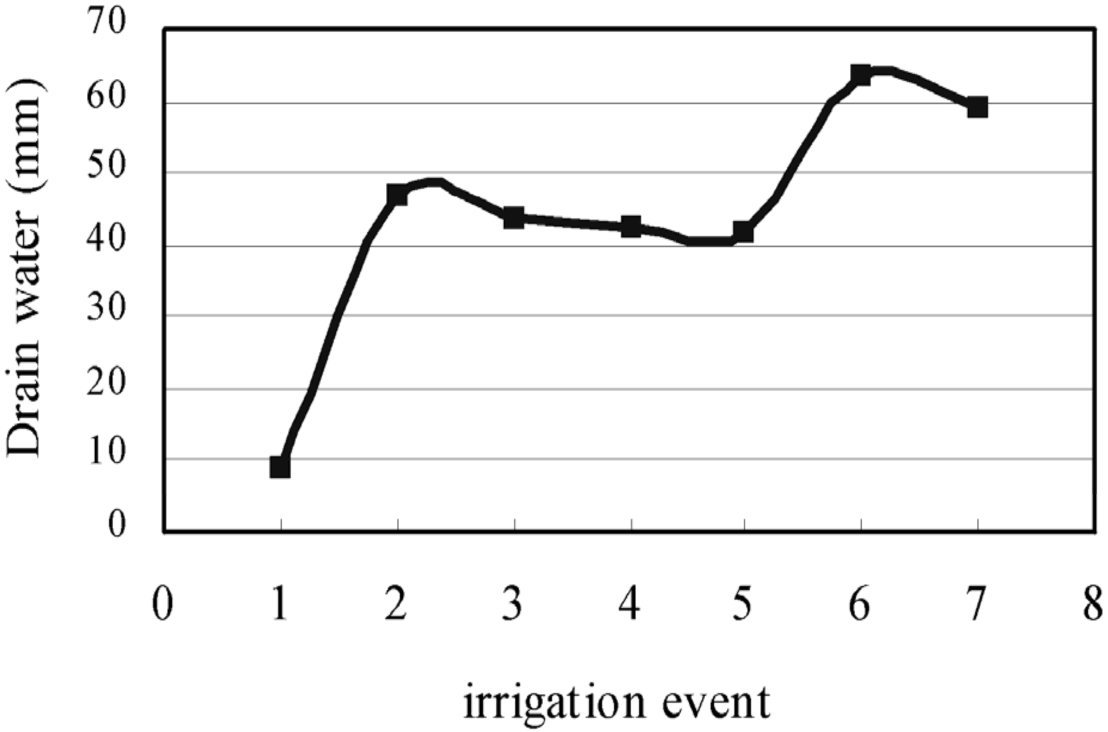
Results and discussion

Average Drainage Water Depths



The drainage water discharged from SI treatments was significantly less than that discharged from FD treatments .

Average Drainage Water in Free Drainage

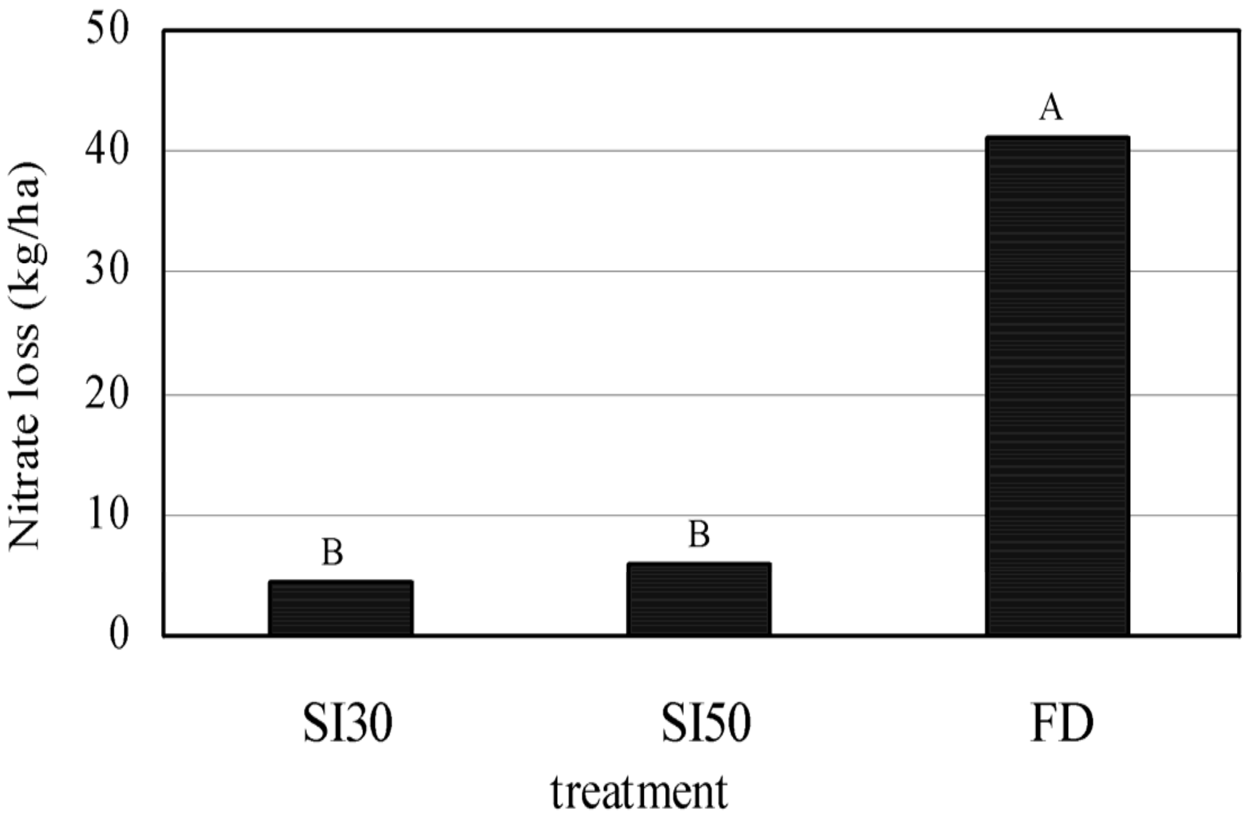


Comparison of NO3-N Concentrations

treatment	Average Mean NO3-N concentration (mg/l)
SI30	2.4
SI50	2.85
FD	13.2

There are significant differences (at 99% level) between NO3-N concentrations in drainage water discharged from FD and SI treatments.

Average of NO3-N Loss



Nitrate losses through drainage water in subirrigation lysimeters were lower than that in free drainage lysimeters.

Average NO3-N Loss

- Nitrate loss from FD-lysimeters was 41 kg/ha, whereas from SI30 and SI50 were 4.4 and 6 kg/ha, respectively

- The reduced nitrate losses can be attributed to a combination of reduced drainage flow and enhanced denitrification in the SI treatments.

Phosphorous Concentration

treatment	Phosphorous concentration (mg/l)
SI30	2.04
SI50	2.15
FD	2.42

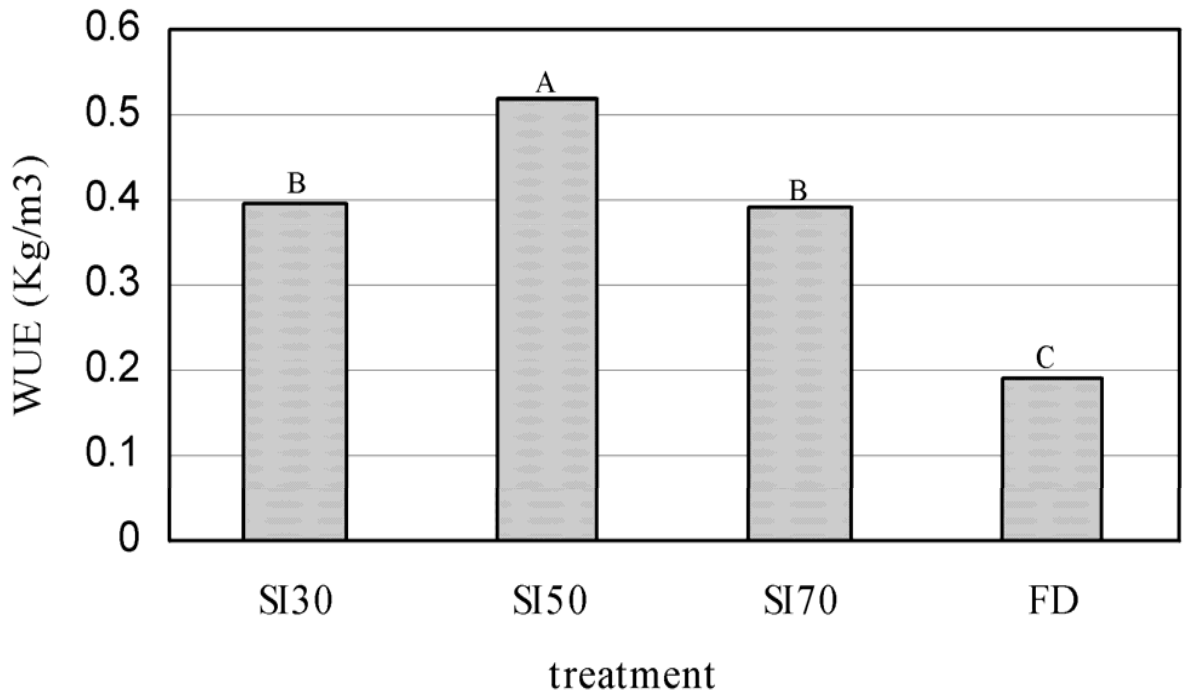
no significant differences were observed in phosphorous concentrations discharged from FD and SI treatments.

EC of Drainage water

treatment	Electrical conductivity of drainage water (dS/m)
SI30	2.6
SI50	2.75
FD	4.56

The average electrical conductivity of drainage water in SI30 and SI50.

Crop production



- The increased yield can be attributed to higher crop water uptake in the SI treatments, in which crop root water uptake is more facilitated.

crop production

- Irrigation water use in SI treatments was lower than that in FD- treatment.

- Water use efficiency was higher in SI treatments.

Conclusions

- Water table management using subirrigation systems substantially reduced nitrate losses and lowered EC in drainage water during the growing season.
- Subirrigation systems considerably increased crop yield, decreased irrigation water application and therefore increased water use efficiency.
- Subirrigation is an effective method in minimizing nitrate and salt load through drainage water and in improving WUE.

Thanks for your attention