Middle East Water and Livelihoods Initiative (WLI)
Improving Rural Livelihoods through Sustainable Water and Land-use Management in the Middle East:
Egypt, Iraq, Jordan, Lebanon, Palestine, Syria, Tunisia, and Yemen

Pilot site Bedoui (South East Tunisia)

Evaluation of on-Farm Irrigation Scheduling of drip irrigated vegetable crops in South East Tunisia

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In arid Tunisia water available for irrigation is frequently very saline. Improved water use efficiency by effective irrigation scheduling and the use of more efficient irrigation system are two possible ways to address the issue of water shortage. Drip irrigation is one of the most effective methods to supply water to crops and it can result in water saving if the correct management procedures are applied. The most common problem encountered with this system amongst growers is that irrigation is applied in excess of crop requirements. In regions with serious water shortage, such a waste cannot be tolerated. Surveys carried out in the area of Médenine show that inadequate management of irrigation has been identified as an important limiting factor to vegetable production, including areas where crops are cultivated under drip irrigation on private wells. The advantage of water savings by drip is forfeited with over irrigated. Following requests received from farmers regarding best management of irrigation waters, field trials have been and are actually conducted within WLI project with the objective to evaluate the impact of drip irrigation strategies with saline water on irrigation water saving, crop and water productivity and soil salinization under the farmers' conditions.

MATERIALS AND METHODS

SITUATION Private farm-Bedoui, Médenine (Tunisia)

CROPS Potato, carrot, green bean & pepper cultivated on sandy soil over contrasting seasons & drip irrigated with shallow well Waters (EC of 6 dS/m)

IRRRIGATION-SCHEDULING METHODS

►Farmer method (FM) consists in giving fixed amounts of irrigation water with fixed intervals from planting till harvest

►Irrigation scheduling methods based on the use SWB to estimate irrigation amounts and timing consist in replacement of cumulated etc. when readily available water is depleted with levels of 100% (FI100) and 70% (DI70)

GUIDELINES FOR COMPUTING CROP WATER REQUIREMENTS FAO-56 (Allen et al., 1998):

Estimate crop evapotranspiration and predict irrigation scheduling of crops by means of SWB model

ETo estimated daily by means of FAO-56 Penman-Monteith method (Allen et al., 1998)

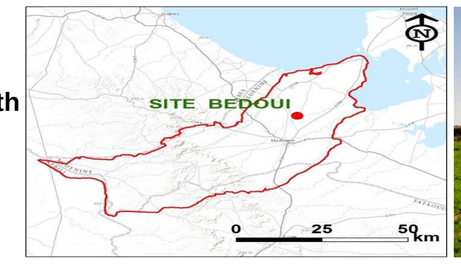
Kc computed following the dual crop coefficient approach: Kc=Ks Kcb + Ke)

Irrigation scheduling ► SWB model

- Daily basis
- Water balance components
- Information on irrigation when RAW (% of TAW) has been depleted

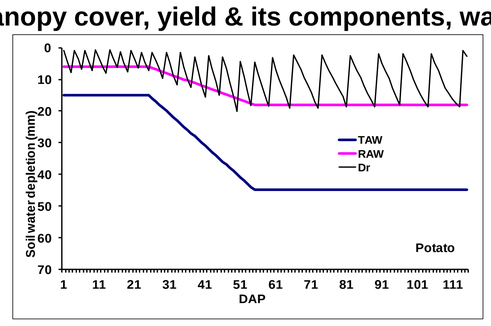
FIELD MONITORING: Soil salinity and water content, ground canopy cover, yield & its components, water supplies (I+R)

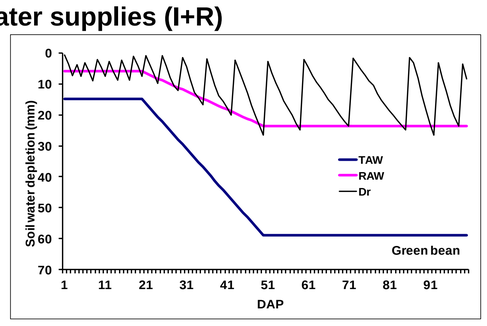
WP (kg/m^3) = Yield (kg/ha) / irrigation water (m^3/ha)

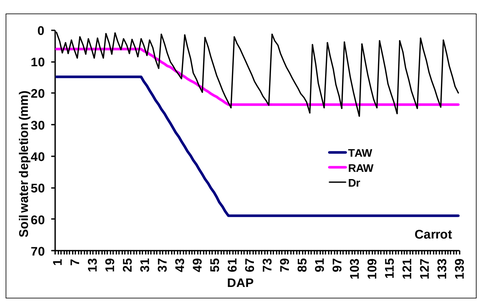


RESULTS

The spreadsheet program develops water balance and supplies information on the date and amounts of irrigation based on cumulative soil water depletion. The SWB irrigation scheduling method keeps the root zone water depletion between the threshold value and field capacity.

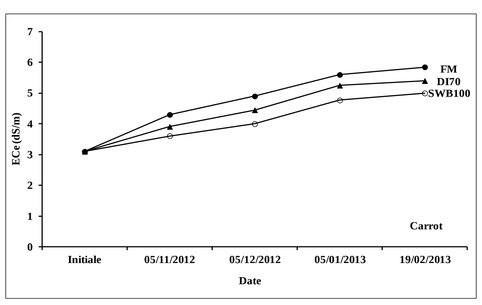


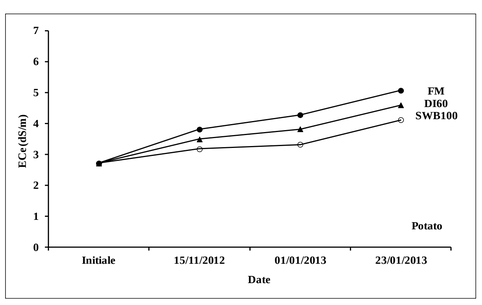


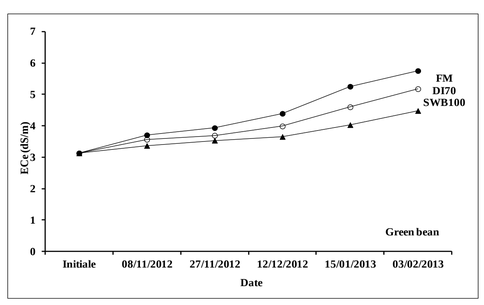


The increase of ECe values observed under all irrigation treatments compared to initial soil salinity is attributed to the relatively high initial ECe and since no rainfall was received during the cropping period and water supply was applied mainly by irrigation, little leaching of the soil is expected.

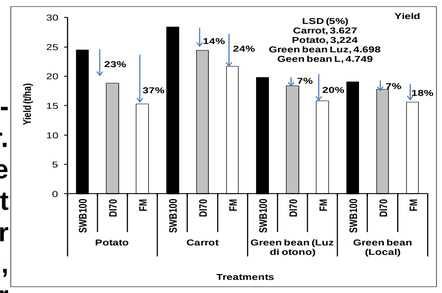
There were decreases in the ECe in full irrigation treatment (SWB100). The reason for the higher soil salinity obtained for treatment DI70 is attributed to absence of substantial leaching under deficit irrigation conditions. The highest ECe values were observed for farmer's irrigation method where more water is applied without adequate scheduling and the high frequency of application during the first stage seem to concentrate salts in the root zone.





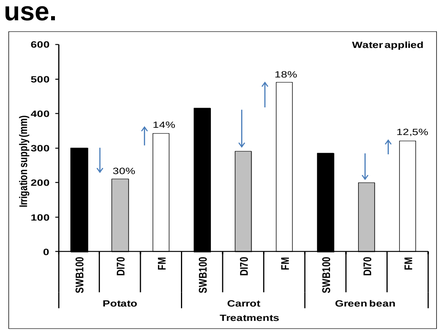


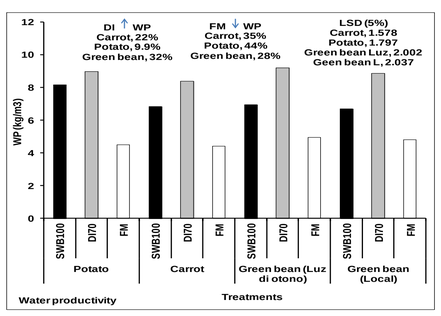
Full-irrigated carrot, potato and green bean grown over fall-winter period used 416, 296 and 285 mm of irrigation water. Water saving achieved from the DI70 was 30% compared to the SWB100 treatment. Farmer's method (FM) caused significant decreases in yield & resulted in using 12 to 18% more water and increased ECe. Lowest WP values are observed for the FM, while the highest values were obtained under DI70. Low WP for the FM attributed to reduced yields & higher irrigation water use.



For all considered crops, maximum yield occurred in the full treatment (SWB100). Yields dropped with the DI70 treatment. Lower yields were observed for the farmer's method. Lower yields obtained under farmer's method may be attributed to the fact that the farmer applies water to the crop regardless of the effective plant needs. He seems to relate irrigation occurrences to days after planting rather than to crop growth stages progress.

The SWB irrigation scheduling based on crop water requirements and soil characteristics resulted in water amounts and intervals adapted to the crop requirement change during the growing season. Its application is only possible when water supply and irrigation amounts can be managed independently by farmer. For a small surface farms where irrigation use shallow well waters, accurate scheduling is manageable and there is high chances to optimize water supply to crops.





CONCLUSION

Full irrigation (SWB100) and deficit irrigation (DI70) strategies offer significant advantages for both yields and WP of carrot crop and reduce the build-up of salinity in the root zone compared to the farmer's irrigation practices. Full irrigation scheduling technique SWB100 could be recommended for irrigation of vegetable crop with the possibility to reduce supply up to 30% in case of limited water availability (DI70).

Deficit irrigation offers a potential way to improve water productivity and to control soil salinization when it can benefit from the leaching capacity of rains. Investigation should focus on this issue and evaluate the efficiency of the small amounts of rain that occur in fall-winter for natural leaching. Conducting the field experiment on farm with the contribution of the farmer will facilitate the extension as the results are fully accessible to the local farmers

REFERENCES

Allen, R.G., L.S. Perreira, D. Raes and M. Smith (1998). Crop evapotranspiration: Guidelines for computing crop water requirements. Irrig. and Drainage Paper N° 56, FAO.