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The Thesis Submitted for the Degree of PhD

(In Filed of Irrigation and Drainage)

Wheat irrigation planning using water deficit index (WDI) and crop water stress index (CWSI) under both drip and surface irrigation in Baluchestan region

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Abstract

Considering the vast area under wheat cultivation in Iranshahr city of Sistan and Baluchistan province, the necessity of proper irrigation planning for optimal use of available water resources is of particular importance. Irrigation planning of agricultural plants with point and field methods and its generalization to other areas is associated with a lot of errors. Therefore, it seems necessary to use a cheap and fast method for planning irrigation in a wide area of vegetation. With the invention of infrared thermometers, the use of remote and near sensing technology by measuring the temperature of vegetation with the aim of determining the irrigation time, has attached the attention of the researchers. Moran's Irrigation Water Deficiency Index (WDI), which is calculated using satellite images, is presented for plant irrigation planning. However, the validation of this method requires comparing it with field methods of vegetation temperature measurement, the most reliable of which is Idso crop water stress index (CWSI). On the other hand, the presence of salts in irrigation water in surface and drip irrigation systems increases soil osmotic force, making changes in these two indices and alters plant irrigation planning during the growth season. To investigate the effect of irrigation water salinity on CWSI and WDI and wheat irrigation planning, an experiment was performed with three different irrigation water qualities in Iranshahr through the 2020-2021 crop year. The experiment was performed as a randomized complete block design with 4 replications and 3 treatments, including (1) irrigation water with a salinity of 0.7, (2) irrigation water with a salinity of 2.5, and (3) irrigation water with a salinity of 2.5 $dS.m^{-1}$. The Idso diagram was drawn for the wheat plant using field collections, and its equations were extracted for January, February, and March months. And similarly, using satellite images for these months, the upper and lower basis line of stress was drawn In Moran's proposed diagram (top and bottom trapezoidal side). The average optimal WDI and CWSI obtained in January, February, and March for wheat are equal to 0.37-0.34, 0.41-0.38, and 0.38-0.37, and for all three months, equal to 0.39 and 0.36, respectively. The value of wheat CWSI in drip irrigation system did not change when salinity increased. In both irrigation systems, the effect of irrigation water salinity on the graph of the WDI index was close to the CWSI index, but in the surface irrigation system, the increase in irrigation water salinity placed the position of the high stress baseline (Tc-Ta) in a higher position. The value of wheat CWSI decreased with the increase of irrigation water salinity, and it showed that the increase of irrigation water salinity reduces the irrigation cycle. The determination coefficients and other statistical parameters obtained from the comparison of these two indices showed the high accuracy of the WDI index. Therefore, the use of WDI index in irrigation planning is confirmed.

Keywords: Saline water, Arid climate, Consuming water, SEBAL algorithm, Vegetation temperature, NDVI, Irrigation management