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Evaluation of the AquaCrop model for barley production under deficit irrigation and rainfed condition in Iran

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ABSTRACT

The AquaCrop simulation model which has been developed by Food and Agricultural Organization (FAO) has the ability to assess the crop production under different irrigation water management. In this research, 2-year data of rainfed barley (2005–2007) from a research project at upstream of Karkheh river basin (Lorestan Province) were used to evaluate the accuracy of the AquaCrop model. The experimental treatments included: rainfed, one irrigation event at sowing time and one irrigation event at spring, that were performed in farmers' fields. The AquaCrop model was evaluated to predict the effect of deficit irrigation and rainfed conditions on yield, soil water content and percentage of green canopy cover. The mean normalized mean root square error for comparison between the measured and predicted values for canopy cover percentage, soil water content, and grain yield were 8.7, 12.4 and 9.2%, respectively, that showed good model accuracy. Efficiency of the model in yield estimation, soil water content and green canopy cover percentage were 0.91, 0.8 and 0.98, respectively. Agreement index for yield was close to 1.0 that showed compatibility of these predicted values with actual values. The results showed that the AquaCrop model is appropriate tool to simulate barley yield under rainfed and deficit irrigation conditions in the study area. This model is a suitable tool to determine sowing date in rainfed conditions based on first effective rain.

1. Introduction

Barley (*Hordeum vulgar* L.) is one of the important crops in irrigated and rainfed areas and it is one of the four important cereals of the world. Barley cultivated area, as the second important crop in Iran, is 1.5 million ha, 60% of which is rainfed (Ansari-Maleki, 2005). Due to its compatibility with various climatic conditions, its positive and valuable characteristics for human and animal feeds, and its importance in food industry, barley has always had a special place in agriculture throughout millenniums. Global production of barley during 2004 has been about 153.83 million tons (Anon, 2006). Referring to the 2009 report by Ministry of Jihad-e-Agriculture, in the crop year of 2008–2009, barley cultivation area in Iran was 1.6 million ha, of which 56.8% was rainfed and 43.2% was irrigated. Barley yield in Iran has been estimated as 3.45 million tons, and amount of yield per hectare in irrigated area is 3293 kg ha^{-1}, while in the rainfed conditions is 1.118 t ha^{-1} (Anon, 2009a).

The country of Islamic Republic of Iran receives approximately 413 bcm of water from precipitation per year, from which 296 bcm goes unutilized through evaporation and evapotranspiration. The climatic conditions in Iran are considered as arid and semi-arid, more than 80% of country is arid and semi-arid, extreme temperature of −20 to +50 degree Celsius is common. Its mean precipitation is about 246 mm, (with average between 50 mm and 2000 mm) which is less than the mean precipitation of the world (Anon, 2010). In addition, the annual potential evaporation in some parts is 20–40 times higher than the precipitation. Long term yield data indicate low barley yield, particularly in rainfed farms with the mean grain yield of 900–1000 kg ha^{-1} (Tahir et al., 1991). The reasons for this may be due to the fact that in cold and highland regions which include 30–40% of the rainfed barley area, mostly low yield is obtained. This low yield is due to susceptibility to frost, dryness, pests, diseases, and local cultivars with low yield potential (Anon, 2010).

The Improper distribution and low amount of precipitation are among general indices of rainfed regions; variations in these parameters cause a high risk, and make the production to change

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