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Nitrogen and water use efficiencies and yield response of barley cultivars under different irrigation and nitrogen regimes in a semi-arid Mediterranean climate

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Experiments were conducted to determine barley cultivars ($Yousef_{six\text{-}rowed}$ and $Nimrouz_{two\text{-}rowed}$) response to different water and nitrogen (N) regimes at Fars Agricultural Research Center using split-split-plot design. There were three levels of water regimes (full-irrigation (I_{100}), 75% and 50% of I_{100}: I_{75} and I_{50}, respectively) in 2010. Rainfed treatment (I_0) was included in 2011. Three N levels (0, 60 and 120 kg ha^{-1}) were used. Grain and biomass water use efficiencies (WUE_g and WUE_b, respectively) were positively affected by N supply. The I_{75} improved WUE_g and WUE_b by 17% and 20% as compared to I_{100}, respectively. Two-rowed cultivar showed higher WUE_g and WUE_b than six-rowed. Nitrogen use efficiency (NUE) was negatively affected by water stress and N fertilization. The highest grain yield was achieved by 120 and 60 kg N ha^{-1} under I_{100} and drought stress conditions, respectively. Two-rowed cultivar showed significantly higher NUE and grain yield than six-rowed cultivar under I_{50} and I_0; by contrast, six-rowed cultivar had similar or higher performances in terms of these traits under I_{100} and I_{75}. This study showed that optimizing irrigation and N rates and selection of suitable cultivars in semi-arid Mediterranean climate might increase NUE, WUE and produce economic grain yield.

Keywords: barley cultivars; grain yield; nitrogen use efficiency; water use efficiency

Introduction

Barley (*Hordeum vulgare* L.) is an important cereal grain crop used as a feeding and/or malting grain around the world (Ullrich 2011). In Mediterranean climate of southern Iran including Fars Province, most precipitation occurs in winter, thus winter cereals such as barley experience some water shortage at booting, flowering and grain filling stages in spring. The booting, flowering and grain filling periods are the most sensitive stages to water deficit (English & Raja 1996). When water is limiting crop production, conservation and efficient use of water are important considerations for agriculture (Katerji et al. 2008).

The main concern in arid and semi-arid environments is water availability and its efficient use (Tavakkoli & Oweis 2004). Irrigation must be supplementary to rainfall in semi-arid regions where water resources are decreasing. In these areas, efficiency of irrigation has to increase to achieve sustainability (Debaeke & Aboudrare 2004). Deficit irrigation is an optimization strategy that is utilized to reduce water use and increase water use efficiency (WUE) in many parts of the world (Sepaskhah et al. 2007).

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