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ONLINE ISSN : 1349-1008

PRINT ISSN : 1343-943X

Plant Production Science

Vol. 11 (2008) , No. 2 250-259

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Effects of Alternate Furrow Irrigation and Nitrogen Application Rates on Yield and Water- and Nitrogen-Use Efficiency of Winter Wheat (*Triticum aestivum* L.)

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(Received: December 6, 2006)

Abstract: A study was conducted in Bajgah (deep water table condition) and Kooshkak (shallow water condition) areas in Fars province in I.R. of Iran to investigate the effects of different nitrogen application rates, deficient irrigation by alternate furrow irrigation (AFI) method and their interaction on the yield and water- and nitrogen use efficiency of winter wheat. The experimental design was split plot with three main plots as irrigation treatments [ordinary furrow irrigation (OFI), fixed alternate furrow irrigation (FAFI) and variable alternate furrow irrigation (VAFI)] and four subplots as nitrogen application rates (0, 90, 180 and 270 kg ha⁻¹) repeated three times. The amount of irrigation water for each irrigation event was considered equal to readily available water of soil in the root zone, and the time of irrigation was determined by the cumulative evapotranspiration (according to Penman-FAO method). The total amounts of irrigation water were 439.0 and 256 mm for OFI and AFI, respectively in the Bajgah area, and 367 and 226 mm, respectively, in the Kooshkak area. Total seasonal rainfalls were 409.0 and 470.5 mm in the Bajgah and Kooshkak, respectively. The results indicated that the interaction between irrigation method and nitrogen application rate was statistically significant for total biomass but not for grain yield and other traits. In terms of grain production, VAFI was superior to FAFI in the Bajgah and Kooshkak areas. VFAI in Bajgah and Kooshkak resulted in 42 and 39% reduction in irrigation water use and 22 and 13% reduction in grain yield, respectively, compared with OFI. Based on the grain yield, nitrogen use efficiency, apparent nitrogen recovery and water use efficiency, it was concluded that VAFI with application of 180 kg N ha⁻¹ is appropriate in the experimental areas. Based on the grain yield and protein

content, VAFI with application of 270 kg N ha⁻¹ was also appropriate due to 21-35% greater production of total protein, although nitrogen use efficiency, and apparent nitrogen recovery decreased by 20 and 16%, respectively, compared with 180 N ha⁻¹. Further, water-use efficiency in VAFI with 180 kg N ha⁻¹ was 0.89 and 0.85 kg m⁻³ in the Bajgah and Kooshkak areas, respectively, which were values not significantly different from those obtained in VAFI with a nitrogen application rate of 270 kg ha⁻¹. Therefore, VAFI with a nitrogen application rate of 180 kg ha⁻¹ is a recommendable practice in the study areas.

Keywords: [Alternate furrow irrigation](#), [Nitrogen application](#), [Nitrogen use efficiency](#), [Water use efficiency](#), [Winter wheat \(*Triticum aestivum* L.\)](#)

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Ali Reza Sepaskhah and Seyedeh Narges Hosseini: "Effects of Alternate Furrow Irrigation and Nitrogen Application Rates on Yield and Water- and Nitrogen-Use Efficiency of Winter Wheat (*Triticum aestivum* L.)". Plant Production Science, Vol. **11**, pp.250-259 (2008) .

doi:10.1626/pps.11.250

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