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RESPONSE OF RHODES GRASS TO VARIABLE RATE APPLICATION OF IRRIGATION WATER AND FERTILIZER NITROGEN

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A field experiment was conducted to study the effects of variable rate application (VRA) of irrigation water and fertilizer nitrogen on the yield of Rhodes grass (*Chloris gayana* Kunth) under two different management zones (MZ). On a 50 ha field irrigated by center pivot, spilt-split plot design was employed with the MZ as two main treatments, the four irrigation levels (I1- 100%, I2- 80%, I3- 60% and I4- 40% of crop evapotranspiration [ET_c]) as sub-treatments and five fertilizer nitrogen levels (F1-240, F2-480, F3-720, F4-960 and F5-1200 kg ha^{-1}) as sub-sub treatments. The mean cumulative Rhodes grass hay yield across three harvests (made in July, September and November 2012) was significantly higher in MZ-2 (24.47 t ha^{-1} per harvest) than in MZ-1 (21.78 t ha^{-1}). Deficit irrigation was found to be a suitable water saving strategy in both the management zones. Across the two zones, irrigation at 80% ET_c resulted in the highest mean hay yields in first and second harvests (7.58 and 8.77 t ha^{-1}, respectively), while irrigation at 60% ET_c resulted in highest hay yield in the third harvest (8.59 t ha^{-1}). By increasing the nitrogen level from 240 to 480 kg ha^{-1}, the cumulative hay yield of the three harvests was increased from 21.70 to 22.18 t ha^{-1} (i.e. increase of 2.21%) in MZ-1 and from 22.75 to 25.38 t ha^{-1} (i.e. increase of 11.56%) in MZ-2, indicating the benefit of VRA of fertilizer nitrogen. Rhodes grass showed differential response to various combinations of irrigation and fertilizer nitrogen levels. A combination of I2-F2 resulted in the highest cumulative Rhodes grass hay yield in both MZ-1 (24.70 t ha^{-1}) and MZ-2 (27.78 t ha^{-1}). Precision fertigation, involving deficit irrigation at 80% ET_c and adopting VRA technology for fertilizer application can be beneficial strategy for enhancing water and fertilizer nitrogen use efficiency for optimal Rhodes grass production.

Keywords: Management zones, soil quality, precision agriculture, Rhodes grass, variable rate fertigation

INTRODUCTION

The demand for forage crops has increased in Saudi Arabia with respect to its large number of livestock (camels, sheep, goats, cattle) which was estimated to be about 3.5 million heads during 2010 (Bakhashwain, 2010). Besides alfalfa, Rhodes grass (*Chloris gayana* Kunth.) has gained importance (Al-Soqeer and Al-Ghumaiz, 2012) and is widely cultivated in Africa, Australia, Japan, and South America and under irrigation in the Middle East for both forage and soil conservation purposes. Rhodes grass is a morphologically variable out-crossing species, which is native to east, central and southern Africa where it occurs in open grasslands. Rhodes grass is considered as one of the important forage crops cultivated under crop rotation system, and it is recognized as a valuable crop for soil conservation because of its rapid establishment ability and spreading habit useful for soil cover and erosion control (Hayes *et al.*, 2010; Yousif and Ibrahim, 2013a).

Rhodes grass was reported to be responsive to N fertilizer (Farnworth and Ruxton, 1974) and requires heavy nitrogen (N) fertilization in order to produce high forage yields. However, heavy N-fertilization causes accumulation of free nitrate in the forage which is unfavorable for cattle (Guggenheim and Waisel, 1977). Spectacular linear response to nitrogen at rates of 275-400 kg ha^{-1} in the presence of adequate phosphorus and potassium, both in yield and in crude protein content was reported; and split applications after each cut or after grazing cycles were found better than one basic application (Skerman and Riveros, 1990). Rhodes grass was reported to respond to N rates as high as 1200 kg ha^{-1} $year^{-1}$ under center pivot irrigation at Marmul in virgin desert soils and provided an annual dry matter yield of 35 t ha^{-1} (Anonymous, 1988). Prakash *et al.* (1994) observed a curvilinear response to high rates of nitrogen fertilization (840 kg ha^{-1} $year^{-1}$), which increased Rhodes grass dry matter yields from 13 to 53 t ha^{-1} $year^{-1}$ with a recommended application of N at 120 kg ha^{-1} per harvest. Vaisman *et al.*