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The thesis Submitted for PhD Degree

(In the Field of Irrigation and Drainage)

**Effect of Airjection Irrigation under Regulated Deficit and  
Partial Root-Zone Drying Irrigation on Quantitative and  
Qualitative traits of Rosmarinus Officinalis L,**

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## Abstract

Food security and water scarcity are among the most important issues that have raised the concern of human societies over the last decade. Therefore, presenting new ways of managing water consumption and increasing production efficiency can be a solution to these crises. On the other hand, inadequate oxygen concentration in the root zone is a limitation for plant performance. However, in the subsurface drip irrigation system, due to stable moisture front, lack of oxygen has a negative effect on plant growth. In order to evaluate the effect of airjection irrigation under regulated deficit and partial root zone drying irrigation on quantitative and qualitative traits of *Rosmarinus Officinalis* L, a field experiment was carried out during 2016 growing seasons at center of seed and plant production of Kerman municipality. The treatments were laid out in split plot on Randomized Complete Block design. The treatments consisted of five irrigation regimes (full irrigation (FI), regulated deficit (RDI<sub>75</sub> and RDI<sub>55</sub>) and partial root zone drying irrigation (PRD<sub>75</sub> and PRD<sub>55</sub>)) in main plot and two levels of oxygenation (O<sub>1</sub>= No injection of oxygen and O<sub>2</sub>= 12 percent oxygen injection) in sub plot. The results showed that the lowest and highest values of herbage fresh weight (5043.7 – 10634.7 kg.h), herbage dry weight (2451.7 – 5145.5 kg.h), plant height (39.2 – 76.9 cm) and number of shoots (73.4 – 148.4) were produced by FIO<sub>2</sub> and RDI<sub>55</sub>O<sub>1</sub> respectively. On the other hand, analysis of plant quality parameters showed that oxygen injection and non-injection only showed a significant difference at full irrigation (FI). However, oxygen injection and non-injection at the same two levels of irrigation did not make any significant difference and PRD<sub>75</sub>O<sub>2</sub> and PRD<sub>75</sub>O<sub>1</sub> were found to be in the best statistical position without any significant differences in all qualitative parameters. Also analysis of water productivity parameters showed that FIO<sub>2</sub>, while the highest water productivity of herbage dry weight, had a significant difference with treatment FIO<sub>1</sub>. However, the injection of oxygen and non-injection at the same two levels of irrigation did not make any significant difference. However, water productivity of oil yield as the most effective ranking parameter in medicinal plants showed that the PRD<sub>75</sub>O<sub>2</sub> and PRD<sub>75</sub>O<sub>1</sub> were in the best position. Therefore, it can be generally acknowledged that increasing the quantitative and qualitative indices of the plant under conditions of oxygen injection is effective while the root zone of development of the plant is saturated and this treatment is recommended if water is not restricted. However, application PRD<sub>75</sub>, with proper root development, enabled better utilization of soil moisture while saving 25 percent in water use and not significantly reducing quantitative indices and increasing qualitative indices compared to control treatment. Therefore, in conditions of water scarcity, PRD<sub>75</sub> can be recommended as the best treatment and solution to overcome the water crisis and to move towards sustainable agriculture in *Rosmarinus Officinalis* L cultivation in Kerman.

**Keyword:** Subsurface Drip Irrigation, Root Aeration, Partial Root Zone Drying, Water Productivity, *Rosmarinus Officinalis* L