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# Studying the Effect of Ammonium Nitrate and Ammonium Sulfate Feeding on the Physiological Efficiency of Water and Nitrogen Consumption in Fennel (*Foeniculum*)

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## Introduction

Various climatic and ecological diversity have made Iran one of the richest countries with genetic reserves of medicinal plants and susceptible to planting these crops. *Foeniculum vulgare* is one of the most widely used medicinal herbs of the *Umbrella* family. This plant has various uses in the food, pharmaceutical and health industries and was formerly used in traditional medicine. Planting time is one of the factors affecting crop yield that causes changes in growth factors. Planting date affects grain yield and protein percentage by varying temperature during different growth periods including grain filling period. Nitrate and ammonium are two forms of nitrogen that are available in the plant. Environmental impacts of nitrogen fertilizer losses manage reduction of fertilizer management and increase efficiency of fertilizer use. Nitrogen remobilization as part of the nitrogen supply required during grain filling period plays an important role in compensating for the nitrogen deficiency at this stage. Therefore, the purpose of this study was to predict the remobilization of nitrogen based on the composition of foliar sprays on fennel and also to investigate the effect of ammonium nitrate and ammonium sulfate on the efficiency of water and nitrogen consumption.

## Material and Methods

In order to predict nitrogen remobilization and effect of ammonium nitrate and ammonium sulfate on the efficiency of water and nitrogen consumption in the fennel, a factorial experiment was conducted in a randomized complete block design with three replications. The first factor consisted of planting date at three levels (first: March 13, second: March 27 and third: April 18) and the second factor was nitrogen fertilizer spraying at three levels (ammonium sulfate (21%),

ammonium nitrate (25%), and no fertilizer) with concentrations of one in a thousand in beginning of budding stage. During the experiment from anthesis to maturity, leaf and stem nitrogen and in the full maturity stage, sampling from each plot of one square meter was done to calculate yield and yield components. Total chlorophyll and total protein was measured. The water use efficiency ($kg/m^3$) was calculated by calculating the ratio of grain yield to the amount of water used during the growing season. In this way, the amount of water consumed (in each circuit based on the amount of water flow) was calculated in time on the land area.

## Result and Discussion

Result shown that increase in nitrogen remobilization rate was associated with decrease in grain yield and this decrease was more pronounced in non-nitrogen and ammonium sulfate application. The process of biological yield decrease with increase of contribution of stem nitrogen remobilization process in yield followed and function of $Y=580e^{-0.13x}$. In this model, the primary biological yield was 580 that, with contribution of stem nitrogen remobilization process in yield at primary yield, the slope of -0.13 start to decline. The evaluation of relationship of nitrogen remobilization to grain after anthesis with yield were shown that, the coefficient "a" was 210, which indicates the highest initial grain yield and this resulted in the lowest contribution of stem nitrogen remobilization process in yield. In the case of coefficient b, which indicates the minimum contribution of nitrogen remobilization process to stem yield. For the coefficient "b", which indicates the minimum contribution of stem nitrogen remobilization process in yield, there was a significant difference between different N fertilizer treatments. The physiological efficiency of nitrogen, which is obtained from the total dry matter produced divided by the absorbed nitrogen, actually shows the relationship between nitrogen availability and dry matter production, and regardless of the consumption of ammonium nitrate and ammonium sulfate in different planting dates, whatever. The physiological efficiency of nitrogen increased to about 36.5, and the efficiency of water consumption was also increased. Therefore, it can be said that the availability of nitrogen in the plant tissue has a positive effect on the efficiency of water consumption. The results of the mean comparison showed that on the first and second planting date (respectively, with 85.3 and 92.9 mg/g of grain weight), ammonium sulfate foliar spraying treatment produced the highest amount of grain protein. Nevertheless, on the planting date of April 20, ammonium nitrate foliar spraying treatment produced the highest amount of grain protein with 81.12 mg/g of grain weight. Regarding the amount of total chlorophyll, the conditions were different. In all three planting dates, ammonium nitrate foliar spraying treatment had the highest amount and it showed a significant difference with two control treatments and ammonium sulfate foliar spraying. The efficiency of nitrogen use in the conditions of foliar application of ammonium nitrate and ammonium sulfate caused a linear increase in water use efficiency, but in the control treatment (no foliar application), nitrogen application efficiency had no effect on water use efficiency. Therefore,

proper nutrition can increase the efficiency of water consumption by increasing the percentage of nitrogen consumption efficiency.

## Conclusions

Considering that nitrogen remobilization as a part of the required nitrogen supply during grain filling period has an important role in nitrogen supply at this stage and it was observed that the contribution of stem nitrogen remobilization process to yield was negatively correlated with grain yield but slope. This negative relationship was slower for ammonium nitrate foliar application, so foliar application with ammonium nitrate at later planting dates could be a suitable strategy to increase the physiological efficiency of nitrogen use to enhance yield.

*Keywords: Anthesis, Exponential function, Chlorophyll, Protein and yield.*

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## Declaration of conflict of interest

*The author declare that they have no conflicts of interest.*