

تأثير التسميد الفوسفاتي والبوتاسي ونوعية مياه الري وقوام التربة
على إنتاجية البرسيم الحجازي ومحتواه العنصري

**Effects of P, K Fertilization, Irrigation Water Quality and Soil
Texture on the Yield and Nutrient uptake of Alfalfa**

قدمت هذه الرسالة استكمالاً لمتطلبات درجة الماجستير في العلوم الزراعية
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نوقشت هذه الرسالة بتاريخ ١٤٢٠/٧/١٨ هـ الموافق ١٩٩٩/١٠/٢٧ م وتم إجازتها.

Summary and Conclusions

The Kingdom of Saudi Arabia is witnessing remarkable development in its animal resources sector. This requires great attention be paid to forage crop production and pastures development. Since alfalfa is considered to be the major forage crop in the kingdom, it is thought necessary to conduct experiments, which could assist in raising the production capacity of land through optimum utilization of the various inputs, especially fertilizers. Water is considered an essential element in the agricultural production in Saudi Arabia, due to its location in arid and semi-arid areas. In order to meet the challenge posed by large-scale needs for water, it is also thought necessary to evaluate other non-conventional water resources such as treated sewage water, which is considered as a rich source of nutrient to crops.

The objective of this research was to evaluate the combined effects of P, K fertilization, irrigation water quality and soil texture on the yield and nutrient uptake of alfalfa.

Field experiments were established at the College of Agric. Experimental and Research Farm at Dirab, South Riyadh, to determine the effects of four P rates applied as DAP (0, 50, 150, 250 kg P/ha), three K rates (0, 50, 100 kg K/ha), applied as K_2SO_4 on yield and chemical composition of alfalfa (*Medicago sativa* L. ; var CUF 101). Two soils were used for this study namely; Loamy and sandy. The experimental design was split-split plot with four replications. The water source represented the main plots, the P fertilization was assigned to the sub-plot and K fertilization was assigned to the sub-sub-plots. The obtained results may be summarized as follows:

I. Effect of treatments on alfalfa dry weight.

The data demonstrated that total dry weight of 10 cuts in the loamy soil, under treated sewage irrigation water varies between 36.9 - 46.7 Tons ha⁻¹ and between 24.4 - 41.7 Tons ha⁻¹ under well water. The corresponding yield data for the sandy soil were 42.5 - 47.1 and 23.1 to 42 Tons ha⁻¹ respectively. It is concluded that sandy soils were superior to loamy soils especially under sewage irrigation water.

The results showed that application of sewage water resulted in a significant increase in alfalfa dry weight under the various levels of P and K. These increases were 12.8% in the loamy soils and 23.4% in the sandy soils. Irrigation with sewage water gave significantly higher yield of alfalfa than that of well water regardless of P and K treatments.

Application of 50, 150, 250 kg P ha⁻¹ gave significantly higher yield of alfalfa grown under well water irrigation. The percent increment in alfalfa dry weight were 16, 29.5 and 35.3% in the loamy soil and (18.1, 24.3, 37.3 %) in the light soil. In contrast, the rate of increase due to P application was less pronounced under sewage water irrigation and amounted only to (1.5%, 4.8%, 7.4%) and (3.8%, 7.6%, 8.6%) in the sandy and loamy soils respectively. The data indicated that regardless of water quality, the yield increased significantly with the application of P over no fertilizer. Addition of 50 kg P ha⁻¹ resulted in 7.8% increase in yield in the loamy soil and 9.8% in the sandy soil. Furthermore the percent increases were 15.5 and 14.5 as a result of 150 kg P ha⁻¹ and 250 kg P ha⁻¹ in the loamy soil. The corresponding values in the sandy soils were 16.5 and 20.5 %.

The data further indicated that the application of K either at a lower rate (50 kg) or higher rate (100 kg) resulted only in minor increase in alfalfa yield. Higher K treatment in the sandy soils gave only 1.2% increase whereas the lower K rate gave 1% increase under sewage

irrigation water. Regarding the loamy soil, the percent increases were 1.7 and 6.1 %. Under well water irrigation, addition of the lower K rate resulted in 8.5% increase whereas the higher rate of K application gave 5.5% increase in both soils. The lack of response to K fertilization may have been due to the higher amount of K being added with irrigation water, particularly in the light textured soil.

II. Effect of treatments on P and K up take

The results demonstrated that sewage water irrigation increased P and K uptake in both soils. Also the results showed that total uptake of P and K by alfalfa was greater in the light textured soils.

The results revealed that highest P uptake was obtained in plots treated with higher rates of P and K (P_3K_2) in the loamy soil. However, in the sandy soil, the highest P uptake was obtained with lower P rate (P_1K_1). The results showed that the higher K uptake was obtained in both soils and under both irrigation waters quality, following the addition of the higher P rate (P_3) with or without K. It is apparent from the data that the total uptake of P and K was more related to yield than P and K concentrations.

III. Effects of treatments on available P and K.

The results demonstrated that the status of available P, under well water irrigation, considerably decreased in the control plots as well as in the P treated plots in both soils. Thus, it is clear that application of P fertilizers did not prevent the decline in available P in the soil. It is worth mentioning that the decrease in the available P was greater in the loamy soil, when compared to the sandy soils. The amount of P fertilizer required to maintain the soil test at its initial level, under well water irrigation, is estimated and it was found that an annual application of 607 and 319 kg P ha⁻¹ would be necessary for maintenance of P in the heavy and light texture soils respectively. The results indicated that in the

present study these amounts were extremely high. The results indicated clearly that the effect of sewage water irrigation was most conspicuous on available P content of the soil and resulted in higher P content as indicated by the soil test data even if no fertilizer was applied.

Soil data for available K, again indicated significant decrease in K level regardless of K additions. The data revealed that the rate of annual K fertilization, to maintain the initial K level for the loamy soil, is 590, 746 and 719, 532 kg ha⁻¹ for the sandy soils under sewage water and well water irrigation respectively.

Based on the obtained results it is concluded that:

1-Alfalfa yield increased significantly by addition of P fertilizer, especially under well water irrigation.

2-Although alfalfa yield were not significantly affected by K additions, yet it is important to add K fertilizers to compensate for K depletion.

3-Finally there is a need for more studies to assess the factors that led to the significant decline in available P regardless of P addition. Also more research should be devoted to evaluate the conspicuous effect of sewage water irrigation that resulted in higher P content in the soil.