University of Zabol
Faculty of Water and Soil
Department of Water Engineering
The Thesis Submited for PhD Degree
(In the Field of Irrigation and Drainage)

Investigating the effect of different levels of biochar and nano-biochar on the quantitative and qualitative yield of quinoa under different salinity and low irrigation regimes

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October 2023

Abstract

In this research, the evaluation of different irrigation regimes and different levels of irrigation water salinity and the effect of simultaneous use of biochar and nano-biochar on some soil characteristics, crop yield and physiological indicators of the medicinal plant quinoa variety Titicaca and simulation of yield with The use of AquaCrop was discussed. Cultivation was done in pots and in the form of completely random factorial design in the greenhouse for two years. The treatments include three levels of irrigation water (I1, I2, I3, respectively 60, 80 and 100% of plant water requirement) and three levels of nano biochar (NB1, NB2, NB3, respectively zero, 2 and 4% by weight of soil) and three Biochar level (B1, B2, B3 and zero, 2 and 4 percent by weight of soil respectively) and three levels of water quality (S1, S2, S3 fresh water and salinity of 4 and 7 deci-siemens/meter). At the end of the growing season, quantitative and qualitative parameters were measured. Also, soil salinity was measured at the beginning and end of the growing season. In both years, the effects of biochar and nano-biochar levels, irrigation water and water quality were significant at the probability level of one and five percent on the measured parameters. The results showed that the index parameters of leaf area, 1000 seed weight, spike weight, yield and water consumption efficiency with the values respectively (92.45, 2.80, 270.96, 1321.52 and 8.70) in nanobiochar treatment. It accounted for the highest amount, which was not significantly different from Biochar treatment. Addition of 2% by weight of the modifier caused an increase in the parameters of leaf surface index, thousand seed weight, spike weight, yield and water consumption efficiency to the extent of (47.12, 2.64, 305.73, 45.45) respectively. 1386, 10/35) The use of 100% water requirement increased the parameters of leaf area index, thousand seed weight, spike weight and yield respectively (47.19, 2.74, 288.81 and 1350.12), which is different from the 80% water requirement treatment.

It had no meaning. On the other hand, the highest amount of water consumption efficiency was observed in the treatment of 60% of water requirement and the amount (10.32). The use of fresh water causes an increase in the quantitative parameters of leaf area index, thousand seed weight, spike weight, yield and water consumption efficiency to the extent of 55.23, 2.68, 304.86, 1219.75 and 14. 9) which was not significantly different from the 4 deci-Siemens treatment. Also, the results showed that the qualitative parameters of protein, proline, carbohydrate, chlorophyll a and b with the sizes (18.64, 14.01, 42.89, 7.78 and 3.48) respectively, in nanobiochar treatment had the highest values. They showed that there was no significant difference with biochar treatment. The use of 2% by weight of the modifier caused an increase in protein, proline, carbohydrate and chlorophyll a and b parameters (20.44, 15.20, 40.45, 9.33 and 4.63) respectively. The parameters of protein, proline, carbohydrate in the treatment of 80% of water requirement with the best sizes (20/99, 12/45, 37/16) had the highest values, which was not significantly different from the treatment of 60% of water requirement. Also, the 100% water requirement treatment showed the highest values of chlorophyll a and b with the sizes (10.45 and 3.82) respectively, which was not significantly different from the 80% water requirement treatment. Salinity treatment of 4 decisimens increased the parameters of protein, proline and carbohydrates by 21.08, 12.69 and 36.95, respectively. Chlorophyll a and b had the highest values in freshwater treatment with the sizes (8.82 and 4.01) respectively. In this study, the ecocrop model was used, and the first year's data was used for model calibration and the second year's data was used for model validation. Due to the high explanation coefficient (R2) of (0.98) and the low RMSE values of (33.38 and 22.08) in the verification stage, it can be said that the performance simulation is in the verification stage. The calibration was better than the

recalibration stage. Also, according to the RMSE values (0.37, 0.33, 0.38, 0.29), it can be said that the model was able to simulate the water consumption efficiency well. According to the obtained results, the use of low and medium levels of biochar and nano-biochar improved plant growth and performance, and the use of higher levels reduced quantitative, qualitative and yield parameters.

Key words: irrigation, drought, biochar, ecocrop.