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The Thesis Submitted for the Degree of Ph.D. (in the field of Agroecology Science)

Application of DNDC model to estimate yield and carbon footprint under different soil tillage of cotton

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Abstract

Conventional tillage methods with no yield increase lead to the loss of resources and emission of greenhouse gases into the environment. To determine the effects of different tillage methods on carbon dioxide (CO_2), Methan (CH_4), nitrous oxide (N_2O) and ammonia (NH_3) emissions in cotton-wheat rotation, an experiment was designed as a randomized complete block including three treatments with four replications at Darab Agricultural Research Station during 5 years. The treatments consisted of direct drilling (no tillage), minimum tillage, and conventional tillage (as control). Data of three initial years of the research were used for model validation. Gases emissions from the cotton-wheat field were estimated using the DNDC 9.5 model in the last two years. Results of model validation showed that the model worked well in simulating the soil environment and gases emissions. The simulation results revealed that the average annual N_2O emissions of 26.50, 21.0, and 15.30 kgN/ha/y were recorded in the fourth and fifth years of experiments for conventional, minimum, and no-tillage treatments, respectively, and the average annual CO_2 emissions were 1858, 2116 and 2259.50 kgC/ha/y, respectively. According to simulation results, peak emission of NH3 from soil occurred on five days after each fertilization in all three treatments. In general, results showed that no-tillage method was more favorable than other cotton cultural practices in cotton-wheat rotation in similar conditions to the present study, can be recommended.

Keywords: Cotton-wheat rotation, denitrification, no-tillage, CO_2, nitrous oxide,