Journal of Water and Soil
Vol. 31, No. 1, Mar.-Apr. 2017, p. 263-276

نشریه آب و خاک (علوم و صنایع کشاورزی)
جلد ۳۱، شماره ۱، فروردین – اردیبهشت ۱۳۹۶، ص. ۲۷۶-۲۶۳

Simulation of Soil Water content and Nitrate under Different Fertigation Strategies for Sweet Pepper in Isfahan by EU-ROTATE-N Model.

F. Fazel[1*]- N.Ganji Khorramdel[2]- M. Gheysari[3]

Received: 11-06-2016
Accepted: 04-09-2016

Introduction: World's population growth and limited water resources and needing to more food production led to interest farmers to use nitrogen fertilizer more than soil requires and subsequently Nitrate leaching causes groundwater and environmental pollution. Therefore, researches has concentrated on improvement of nitrogen use efficiency, which numerical simulation is the effective solutions to optimize the management of water and fertilizer in the field in order to achieve the maximal yield and minimal nitrate pollution of soil, groundwater and drainage in water deficiency crisis condition. For this reason, the evaluation of new user friendly models in correct estimation of soil moisture and nitrogen content distribution and recognition of water and solutes movement in the soil and choosing the best management option for increasing productivity and economic performance and also reduction of nitrate pollution of soil and ground water source with the least limitations and high accuracy is necessary. The Eu-Rotate-N model has been developed for simulation of nitrogen use and specifically for optimization of nitrogen use in variation of vegetables in a wide range of conditions, which without the need to calibration has presented satisfactory results in many areas. So this study was conducted to evaluate the efficiency of Eu-Rate-N model in assessment of moisture and nitrogen distribution and yield under different nitrogen fertigation management for pepper plant.

Materials and Methods: Sweet pepper was planted at density of 8.33plant per m2 in a row planting method. 150kg per hectare per year of fertilizer was used during the season. Crop yield, soil water and nitrogen content were measured on a regular basis. The treatments consisted of three fertilizer level: zero (N0), the ratio of ammonium to nitrate 20:80 (N1) and 40:60 (N2), which was conducted in a completely randomized block with three replications in Isfahan. Irrigation based on daily monitoring of humidity was used with drip irrigation system. The irrigation Depth was calculated and applied with aim of replacing the water content deficiency in the root zone up to field capacity (FC) for the no water deficit treatment.

Coefficients were modified only for plant coefficients and length of each growth stage according to the area. To compare simulated data with measured data in field, indices of statistical root mean square error (RMSE), normalized root mean square error (NRMSE), coefficient of determination (r2) and index of agreement Wilmot (d) were used.

Results and Discussion: The NRMSE index for nitrate and soil water content was 11.45, 12.08, the RMSE was 0.89, 0.022, the r^2 was 0.998, 0.996 and the d was 0.667, 0.66 respectively. All calculated indices for soil water and nitrate content were in the acceptable range. NRMSE index was less than 20 percent in all treatments which was indicating good ability of model in simulating soil water and nitrate content and r^2 was more than 90 percent which pointed out to well process of simulation of the model. The simulation accuracy was greater at the end of the growing season. Comparing of RMSE statistical index for different depths showed that the simulation accuracy was increased by increasing depth which can be due to changes in surface evaporation and also the effect of environmental factors on surficial layers more than other layers. Generally the best simulation was related to the layer of 80 to 100 cm. And the average RMSE was 0.019 cm^3 per cm^3 for soil moisture content and 0.22 mg per kg for soil nitrate.In the layer of 80-100 cm the best simulation of soil moisture and nitrate content between treatments was related to N_0 by the RMSE equal to 0.024 cm3 per cm3 and 0.21 mg per kg respectively and the weakest simulation was related to N_3.The simulated yield in all treatments was less than its actual value. Comparison of simulations between three treatments demonstrated the usefulness of EU-Rotate N to examine the effects of management on, nitrate leaching.

1 and 2- M.Sc. student and Assistant Professor, Water Engineering Department, College of Agriculture, Arak University
(*-Corresponding Author Email:forough_f67@yahoo.com)
3- Associate Professor, Water Engineering Department, College of Agriculture, Isfahan University of Technology

Conclusions: The Eu-rotate-n model without calibration for site location was well capable of estimating soil water and nitrate content under different fertilizer management for Isfahan climatic conditions nevertheless it is suggested to use to calibrate yield functions to improve the yield simulation. Generally we can use Eu-rotate-n model for simulation of water and nitrogen content and eventually approach to integrated and optimal management in the farm in the hot, dry conditions of Isfahan.

Keywords: Fertigation, Nitrate pollution, Sweet pepper, Soil moisture distribution