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Editorial

Study of the Soil Water Movement in Irrigated Agriculture II

George Kargas, Petros Kerkides and Paraskevi A. Londra *

Department of Natural Resources Development and Agricultural Engineering, Agricultural University of Athens, 75 Iera Odos Str., 11855 Athens, Greece; kargas@aua.gr (G.K.); kerkides@aua.gr (P.K.)
* Correspondence: v.londra@aua.gr

This Special Issue of *Water* is the second part of the series "Study of Soil Water Movement in Irrigated Agriculture" [1] and further contributes to the literature by addressing recent developments in various aspects of this subject.

Agriculture is the main consumer of water. Especially in arid and semi-arid regions, approximately 80% of water is drawn for crop irrigation. Both rational water management and an increase in the efficiency of water use are solutions to meeting the increasing water needs and the declining water resources.

An important solution to this problem is saving irrigation water via an appropriate irrigation method. To date, extensive research has been conducted on the role of several soil, climate, and plant parameters, as well as on the characteristics of irrigation methods affecting their efficiency. Knowledge of these parameters, their role, and their interaction could help in studying water movement in irrigated agriculture and in developing simulation models of surface irrigation, subsurface irrigation, or the pointwise application of water under high-pressure conditions [2–4].

Another important process to study is infiltration. Soil hydraulic properties play a crucial role in infiltration, as they control the infiltration process, and soil water and solute movement. Modeling and flow simulation of soil water movement depend on an accurate description of the hydraulic properties and their measurements (in situ and in the laboratory). Obtaining infiltration equations that accurately estimate the amount of water infiltrating the soil always remains an open issue [5,6].

Closely related to irrigated agriculture is the problem of salinity of irrigated soils. The accumulation of salts in the rhizosphere has many important impacts as it can reduce plant growth and yields. The salinity problem is usually solved through salt leaching by applying additional water in excess of the crop's water requirements to move the salts below the root zone. However, an accurate estimation of the amount of additional water depends on the electrical conductivity of the saturated soil paste extract (EC_e), which is the standard method for determining soil salinity. Additionally, the composition of the soil solution affects the composition of the cations on the exchange surface of soil particles, affecting the soil permeability and hence the infiltration of water. Many researchers have suggested methods for more easily determining electrical conductivity using various soil-over-water extract mass ratios instead of EC_e. Furthermore, considerable work has been carried out to estimate the conversion factor of various EC methods to EC_e values. Among the factors that influence the value of the conversion factor is soil texture [7].

Additionally, closely related to the successive cycles of wetting and draining are various phenomena such as denitrification. The role of high iron content under wetting and draining soil conditions in denitrification is a subject to be investigated [8].

This Special Issue of *Water* contains seven papers covering many aspects of the above-mentioned challenges [2–8], and a wide range of different regions and conditions.

Fuentes et al. [2] investigated the reliability of the hydrodynamic model in simulating the advanced phase in border irrigation. To solve the hydrodynamic model, the Kostiakov, and Green and Ampt infiltration equations were used and compared. Comparing the two

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equations, the empirical Kostiakov equation is shown to be only representative of a specific irrigation event, while the Green and Ampt equation can be used to model the subsequent irrigations, and the advance/infiltration process can be observed in detail.

Zamani et al. [3] developed a model to simulate the soil wetting patterns in subsurface drip irrigation systems. This model combines the subsurface drip irrigation lateral characteristics with the soil hydraulic properties and uses the Hydrus-3D software as a complementary section of the model to simulate the wetting front beneath the lateral pipes. The results showed that the model provides good estimations of the emitter flow rates, as well as realistic wetting patterns. Therefore, the application of this model can improve the design accuracy; optimize the water management; and consequently reduce water, fertilizer, and nutrient losses. Applying and evaluating the performance of this model in field conditions is recommended.

The study of Walczak et al. [4] aimed to determine the dynamics of the spatial distribution of a soil moisture front, caused by the pointwise application of water under high-pressure conditions. The study was composed of six independent experimental series in which a sand monolith was supplied with water doses of 250, 500, 750, 1000, 1250, and 1500 cm^3 under a pressure of 4 bar and the volumetric soil moisture was measured using TDR sensors. The primary cause of water movement at the moment of injection was demonstrated to be the pressure potential gradient of water. In the course of water injection, a risk of disturbing the structure of the porous material was also observed. The correctness of the adopted method was verified by calculating the water balance.

You et al. [5] examined the role and characteristics of preferential flow in understanding soil water transportation, especially in agricultural irrigation management and for improving cropland water use efficiency in arid and semi-arid areas. Seventeen dye tracer experiments were conducted in the field. The effects of fracture, rainfall intensity, rainfall duration, and surface slope on solute migration and farmland runoff were analyzed through the parameters of infiltration depth, dyeing area, saturation, runoff coefficient, and rainfall infiltration coefficient. The results showed that increasing the rainfall or irrigation intensity could promote the activation of the fracture channel as the preferential flow channel. The preferential flow channel slowed the formation of runoff, reduced the velocity of slope flow and increased the amount of soil water infiltration.

Argyrokastritis et al. [6] proposed infiltration equations to describe horizontal and vertical infiltration under various ponding heads incorporating the actual contribution of the pressure head gradient to the flow. Six soils with known hydraulic properties, covering a wide range of soil textures, were used. To validate the accuracy of the proposed equations, the solutions to horizontal and vertical infiltrations provided by the proposed equations were compared with numerically simulated ones provided by the Hydrus 1-D software. An analysis of the results showed a very good agreement in all studied soils.

Kargas et al. [7] studied the effect of soil texture on the conversion factor of 1:5 soil/water extract electrical conductivity ($EC_{1:5}$) to saturated soil paste extract electrical conductivity (EC_e). A total of 148 soil samples with different soil textures and salinity levels from three regions of Greece were used, and the EC_e value, $EC_{1:5}$ value, and clay and sand contents were determined. The results showed that the conversion factor can be estimated using an equation that incorporates the clay and sand contents through the soil saturation percentage and can give a fairly good prediction of EC_e from $EC_{1:5}$ (R^2 = 0.9887 and RMSE = 1.39 dSm^{-1}).

Zhang et al. [8] examined the influence of drying–rewetting cycles on ferrous iron-involved denitrification in paddy soil. The dynamics of nitrate, ammonia, Fe^{2+}, Fe^{3+}, total organic carbon, and nitrous oxide were investigated using iron-rich paddy soil in Jiangxi province, South China. There were complex interactions among organic carbon, nitrate, and Fe^{2+}/Fe^{3+} under the drying–rewetting cycles. Soil rewetting led to denitrification flush, especially after a moderately long drying period, while excessively frequent drying–rewetting alternations were not favorable to nitrate denitrification.

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