

Water and Solute Dynamics in Porous Media

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Abstract

The aim of this study is to present briefly a two dimensional model for describing the movement water and solute transport in two types of rockwool slabs – Floriculture, a high density and Expert with a low density one – water movement is described by Richards equation which is implicitly solved using the control volume finite element method. The governing convection dispersion equation described the solute transport is explicitly solved. Numerical solutions are obtained for the water distribution and also for the concentration of solute. The model is validated by comparing the results of water transport developed by this model with experimental results.

Keywords: *Simulation, Two dimensional, Water transport, Solute transport, Rockwool.*

1. Introduction

The soil less crop substrates should be a starting point for management models that can be used to obtain growth systems, with minimal input of water, nutrients, and pesticides, with a high production of good quality and with a minimal nuisance to the environment. These systems are better defined and controllable. For these reasons [1] determined the hydraulic and physical proprieties of two rockwool slabs types, Floriculture with a high density and Expert with a low density one, after this [2] introduce these values for simulating the water movement by the use of Computer Dynamics software [3], the numerical results were then compared and validated with experimental results [2]. In the same context [4] analyzed the solution motion in a rockwool slab by the model of sources and sinks which is simple and the results obtained are validated the experimental ones

In this study the hydraulic and physical proprieties with the experimental values are used for validate the numerical model developed for simulating the water movement and the solute transport. For describing water movement and solute transport several codes were elaborated: HYDRUS [5] used finite element method, FUSSIM [6] used the control volume finite element method and [2] transformed the Navier- Stockes equations used by the CFD software [3] to the standard transport equations. In this study we formulate a two dimensional numerical model

for describing water movement and solute transport, it is used to solve implicitly the Richards equation [7] for unsaturated porous medium with the control volume finite element method, giving water transport and it is solved explicitly the governing convection dispersion equation [8,9] for solute transport, followed by the general expressions of boundary and initial conditions. We compared and validated the results of water transport for the two types of rockwool: Floriculture and expert developed by this model with the experimental results [2]. The model developed also the results of solute transport: Scenarios of concentration distribution.

2. Materials and methods

The field of simulation is two types of rockwool slabs [2] used as growing substrates, manufactured by the Grodan company: Floriculture, with high density and Expert with a low density. The dimensions of each one are: 7.5cm depth, 100cm length. Two drippers are located on top of the planting and the drain is located at lower right corner. Geometry, position of the drippers and drainage slot are recapitulated in Fig. 1.

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