Problem 5-14

Consider a 1 m profile of sandy loam soil with van Genuchten parameters K_s = 4.42 cm h^{-1}, α_{VG}= 0.075 cm^{-1}, n = 1.89, θ_s = 0.41 cm^3 cm^{-3}, θ_r = 0.065 cm^3 cm^{-3}. The initial water content is θ_i = 0.15 cm^3 cm^{-3}. The crop is corn with a root density summarized in the table below. What will be the water content in the profile after 5 days if the potential transpiration (T_p) is 7 mm d^{-1}?
Assume the model of van Genuchten (1987) for calculating root water uptake, S

$$S = \frac{S_{max}(z)}{1+\left(\frac{h}{h_{50}}\right)^p}$$

and

$$T_p = \int_0^{Z_r} S_{max}(z)dz$$

where S_{max} is the potential root water uptake, Z_r is the root zone depth, h_{50} is soil pressure head corresponding to a 50% reduction in root water uptake and p is empirical shape factor. Assume h_{50} = -500 cm and p = 3. Repeat your calculations with h_{50} = -100 cm

Table 5-2: Root density with depth

Depth (cm)	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
Root density (%)	30.5	20.5	15.5	10.5	8.5	6.5	3.5	2.5	1.5	0.5

Make the calculations using HYDRUS-1D (Šimůnek et al., 2005) with the following conditions:

- One-dimensional homogeneous soil profile 1 m deep.
- Duration of simulation: 5 days
- Soil material: Sandy loam
- Discretization: 101 nodes equally distributed with depth (i.e. 1 cm per element)
- Initial condition: Water content is 0.15 cm^3 cm^{-3}
- Lower boundary condition: Constant water content of 0.15 cm^3 cm^{-3}

Answer:
See HYDRUS-1D modules 5_14A.h1d and 5_14B.h1d. The water content profiles are plotted below (Figure 5-10).

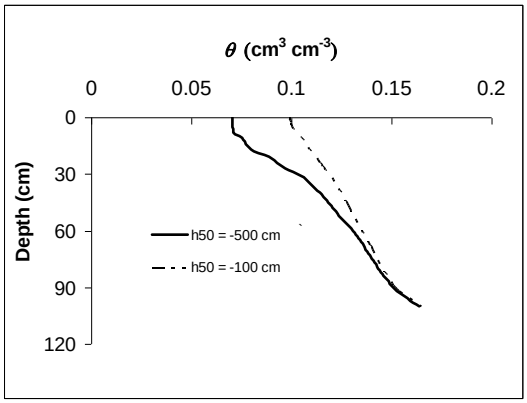

Fig. 5-10: Water content profiles for contrasting values h_{50} = -100 and -500 cm