Water Dynamics in Plant Production, 2nd Edition

Questions and Discussion Points

Chapter 5 – Water Storage and Movement in Soil

Section 5.1
1. Explain the term ‘soil moisture characteristic’.
2. Please estimate from Fig. 5.1 the content of plant-available water (vol. %) for the clay soil, the silt loam soil and the sandy soil. The field capacity (FC) is taken as being equivalent to a tension of 316 cm, 100 cm and 63 cm height of a water column for these clay, silt loam and sand soils, respectively. The permanent wilting point (PWP) corresponds to 15,000 cm.
3. Please derive the pF for the four tensions given in question 2 above.
4. Calculate the quantity of plant-available water for an 80-cm profile of the three soils presented above.
5. Using the ancillary idea of an ‘effective pore diameter’ characterizing the width of soil pores retaining water, one can use Eqn 4.2 to relate pore diameter to water tension. By use of this relation and of Fig. 5.1 please calculate the pore size distribution of the clay soil and the sandy soil. For the pore size distribution subdivide the total pore volume into the pore classes > 300 µm, 300–30 µm, 30–3 µm, 3–0.2 µm and < 0.2 µm.
6. Please state the reason, why seepage of drainage water does not stop after the soil has reached FC at pF 2 or so.
7. Please explain why, in Example 2, *Case A*, there is no water flow between P_2 and P_1, although the matric potential is lower at P_1.
8. Please discuss why the hydraulic conductivity functions differ between soils of different textural class as shown in Fig. 5.3.

Box 5.1
1. Explain the mode of operation of a tensiometer.
2. Describe and explain the reasoning behind some methods for measuring gravimetric soil water content.

Section 5.2
1. Explain the difference between total or global radiation and net radiation.
2. Part of net radiation drives the evaporation process. How does the radiation balance shift, when the soil dries and the actual evaporation rate slows down?
3. State the difference between latent heat flux and sensible heat flux.
4. What is advection?
5. Explain the term ‘potential evaporation’.
6. To calculate daily potential evaporation using the Penman equation (Eqn 5.6 including Eqn 5.7), which weather variables have to be measured?
7. Explain the three stages of soil evaporation.
8. Coarse-textured soils or aggregates of cohesive soils can induce a smaller water loss by evaporation than fine-textured soils or those that have been compacted, such as in traffic lanes. How do you account for this phenomenon and what is the agricultural significance?

Section 5.3
1. Explain the words ‘infiltrability’ and ‘final infiltrability’.
2. Describe the process of water infiltration into soil of moderate wetness at modest and high rainfall rate. You can support your account by considering the water content profile as a function of time after the onset of rain.

3. At sufficient rainfall rate, the infiltrability of soils will decrease. What is the main reason?

Box 5.2

1. Please explain the factors that can result in preferential flow.