

**NATIONAL UNIVERSITY OF LESOTHO  
FACULTY OF AGRICULTURE**

**SSR 611: SOIL AND PLANT WATER RELATIONSHIPS**

**MAY 2011**

**MARKS: 100**

**TIME: 3 HOURS**

**INSTRUCTIONS:**

- 1. ANSWER ANY FIVE (5) QUESTIONS.**
- 2. MUST COMMENCE A QUESTION ON A SEPARATE SHEET.**

## SSR 611 SOIL AND PLANT AND WATER RELATIONSHIPS

1.
  - a) Illustrate, with a well labeled diagram, and discuss the distribution of the roots-water extraction process within the soil profile. 5/
  - b) Discuss the mechanisms that drive the water movement from the soil solution into the roots, and through the stem to the leaves. 5/
- 2.

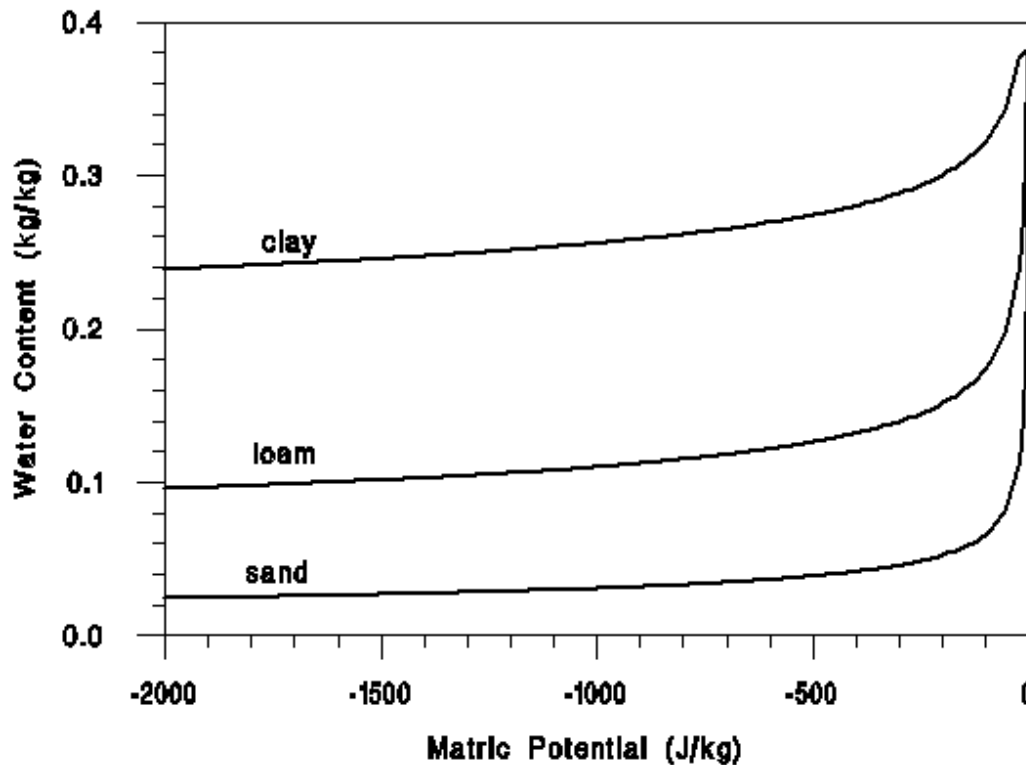


Fig. 1: Typical moisture release curves or moisture characteristics for sandy, silty and clay soils.

- a) The upper limit of wetness for completely drained sandy and clay soils, as defined at water potentials between -10 and -33 J/kg, respectively, is known as ----- 1/
- b) ----- tend to have high bulk densities (1.6 Mg/m) while ----- textured soils tend to have lower bulk densities. 4/
- c) Determine the values of the water content at -33 J/kg and -1500 J/kg for each of the soil textural groups. 5/
- d) Calculate the depth of plant available soil water content for each of the soil textural groups, assuming the plough depth. 10/

3.

- a) Soil permeability generally declines with (*increased/decreased*): 10/  
(i) -----compacted soil layers  
(ii) -----soil water content  
(iii) -----soil organic matter  
(iv) -----clay content  
(v) -----soils with smaller pore sizes.
- b) Explain the eco-physiological structure of plant roots that govern their local rate of water uptake, under both conditions of surface and subsurface irrigation. 10/

4.

- a) Discuss four factors that may be influence the depth of crop water requirement. 10/  
b) Explain the concept of “management allowable water deficit/depletion, MAD” for irrigation schedules. 10/

5.

- a) Estimate gross depth of irrigation water (IW) per application needed to bring the rooting zone of tomatoes in loamy soils to field capacity. 5/

**Given:** it is possible to infiltrate 40 mm net equivalent depth of available water ( $d_{paw}$ ) per application. IW was initiated once for tomato transplants with 60% efficient surface irrigation systems, whenever accumulated  $(ET - P_{eff})$  exceed 31 mm (i.e. approximately 78 % MAD) during October.

$$IW = 100/I_{eff} (d_{paw}).$$

- b) Calculate the number of irrigation applications over the total growing season. 10/

**Given:** the total monthly IW needed for the subsequent months of tomato growing season (October to March) showed increased daily  $(ET - P_{eff})$  % canopy cover due to growth stage, was thus  $(+ 110 + 166 + 195 + 180 \text{ mm/month}) = 718 \text{ mm}$ .

- c) Calculate the irrigation interval (INT) in days for the net irrigation water demand for a tomato growing season. 5/

6.

- a) Draw graphs, that can relate the cumulative evapotranspiration (ET, mm) of water (from the seasonal precipitation) that resulted in maximum yield of grass leys (aboveground biomass yield, ton/ha) harvested from the **conservation and conventional tillage** experimental data at the FOA farm. 10/  
b) Discuss the determination of the irrigation or precipitation water use efficiency. 10/