

# Water Dynamics in Plant Production, 2nd Edition

## Multiple Choice Questions

### Chapter 16 – Breeding for Yield and Water Use

1. In modern varieties of wheat there is evidence of differences in a number of plant characteristics compared with those of older varieties. Which of these characteristics have the greatest effects on grain yield? (There may be more than one correct answer.)

- (a) biomass yield
- (b) harvest index
- (c) duration of plant growing season
- (d) leaf area index
- (e) green leaf area duration after anthesis
- (f) total evapotranspiration
- (g) total evaporation
- (h) total transpiration
- (i) biomass transpiration efficiency

2. Many of the efforts in breeding cultivars for water-limited environments have been summarized in the equation:

$$Y_G = ET \cdot (T/ET) \cdot TE \cdot HI$$

where  $Y_G$  is the economic or grain yield,  $ET$  is the cumulative evapotranspiration,  $T$  is the transpiration,  $TE$  is the biomass transpiration efficiency and  $HI$  is the harvest index. Which of the following can have a marked effect on the proportionality factor  $T/ET$  in a Mediterranean climate? (There may be more than one correct answer.)

- (a) reducing soil evaporation in the early period of crop growth
- (b) increasing the rate of crop growth
- (c) increasing the length of the growing season
- (d) shortening the period before anthesis

3. An important factor in transpiration efficiency ( $TE$ ) can be the proportion of total water use that takes place when the vapour pressure deficit of the atmosphere is large ( $WU_{\Delta D}$ ). Why does reducing  $WU_{\Delta D}$  improve  $TE$ ?

- (a) Lowering  $WU_{\Delta D}$  reduces photorespiration.
- (b)  $WU_{\Delta D}$  is a measure of plant-available soil water.
- (c) Less water is lost from soil by evaporation.
- (d) Less water is used per unit of carbon fixed when vapour pressure difference is small.

4. In the analysis of the performance of genetically modified plants, slower growth has been associated with more water being available during grain fill in plants that appear to be more resilient to water stress. Other experiments suggest that slower early growth can:

- (a) be associated with greater risk of disease
- (b) shorten the period of grain fill
- (c) increase soil evaporation
- (d) all of the above

5. The discrimination of  $^{13}\text{C}$  to  $^{12}\text{C}$  in plant tissues relative to the ratio in air is an indication of the ability of plants to reduce  $\text{CO}_2$  in the internal spaces of their leaves. It is also inversely proportional to the transpiration efficiency. However, more detailed analyses have shown that the level of discrimination between the two isotopes of C can result from two physiological mechanisms. Which of the following mechanisms can affect the discrimination?
- (a) Increased thickness of leaves under water stress enhances light interception and reduces the temperature in the substomatal cavity.
  - (b) Thicker water films in substomatal cavities decrease TE.
  - (c) Partial closure of stomata reduces stomatal conductance.
  - (d) Increased photosynthetic capacity.