

Water Dynamics in Plant Production, 2nd Edition

Questions and Discussion Points

Chapter 12 – Influence of Nutrient Supply on Water Use and Establishment of Yield

Section 12.1

1. A sufficient water supply improves the effect of nitrogen (N) application on yield performance compared with limited water (Fig. 12.1). Water in the soil can affect not only N availability in the sense of soil N abundance, N formation and N transport from soil to roots, but also the plant's capability to acquire the nutrients. Please discuss the various aspects of N availability and make the contrast with N acquisition.
2. Describe the combined effect of water and N on biomass yield by applying the law of the optimum.
3. N uptake by crops depends on N application rates and on water supply (Fig. 12.1). What is the important inference for N application rates in dry areas from an economic and ecological point of view?

Section 12.2

1. In the field experiment in Texas (Fig. 12.2), nitrogen (N) application of 210 kg ha⁻¹ nearly doubled total and grain yield, when additional water was applied by irrigation (Table 12.1). But the increase in water use was relatively small. When not irrigated, the N effect on yield was much smaller. Please discuss the N effect on yield and water use under the conditions of limited and plentiful water supplies.
2. Try to specify a number of reasons why the heavy stimulus of irrigation to crop growth and yield was not paralleled by an associated greater water use.
3. Please give the definition of 'harvest index' (HI). The HI signifies an important process in yield formation. Please explain.
4. HI is small when large N applications are followed by limited water supply. Try to explain.
5. In the Texas experiment, which combination of factors achieves the largest water use efficiency (WUE) for biomass and grain yield?
6. The fertilizer experiments in Germany, near Bonn, exemplify the understanding that, in addition to N, other factors have to be considered that contribute to soil fertility and yield development. Describe the results of the Bonn experiment and try to link the outcome with the 'law of the optimum'.
7. What is meant by 'unproductive transpiration'?

Section 12.3

1. The pot experiment with sugarbeet showed a relationship between total yield (beet and top) and water use (Fig. 12.4A), thereby underpinning a statement of de Wit from 1958. Discuss this statement in view of Fig. 12.4A.
2. The pot experiment with pearl millet grown on infertile sandy soil, ameliorated with additions of phosphorus (P) fertilizer seems to conflict with the sugarbeet experiment. Discuss the result of the P-fertilizer experiment and try to provide a physiological explanation for the effect of P on transpiration efficiency (TE).
3. Nutrient additions are an effective tool to improve water use efficiency (WUE). Please contrast the effect of fertilizer addition on TE and WUE.