

By

L.A.W. Ballard

(Waite Agricultural Research Institute, University of Adelaide)

14. 11. 33

-----000-----

INTRODUCTION.

It has been known for many years (Wilfarth, 1905) that the ratio of the amount of water transpired during the life period to the amount of dry matter elaborated, or transpiration ratio, of plants abundantly supplied with nitrate is smaller than that of plants with a lower nitrate supply, and this has been substantiated by later workers (Crist, 1926; Trumble, 1932). Although nitrate supply is known to have a pronounced influence on the growth and metabolism of the plant, the physiological interpretation of its effect on transpiration ratio is still obscure; it is therefore proposed in the present work to analyse this effect and endeavour to elucidate it in terms of the physiology of the plant.

THEORETICAL CONCEPTION OF TRANSPIRATION RATIO.

In this section a general expression will be derived relating transpiration ratio to the drifting size and water loss of the plant during its life-period. In the light of existing data we may then consider the effect of nitrate supply on the components of the expression, and also seek for possible mechanisms by which these effects may be produced.

If y = total amount of water lost between zero time and any other time t , W = dry weight at time t , and T = value of t in days at harvest,

$$\text{Transpiration ratio} = \frac{y_T}{W_T}$$

Also

$$\frac{dy}{dt} = rW,$$

where r = rate of transpiration per unit dry weight of plant, and is a function of t .

Therefore

$$y_T = \int_0^T rW dt,$$

and

$$\frac{y_T}{W_T} = \int_0^T r \frac{W}{W_T} dt. \quad \dots \dots \dots (1)$$

The quantity $100W/W_T$ is the percentage of the maximum dry weight attained at any instant. This percentage and the transpiration rate, r , are thus determinants of transpiration ratio.

Petrie (1932) has considered the case of two plants growing at different rates, and has indicated that, if harvesting is deferred till both

SUMMARY.

The effect of nitrate in reducing transpiration ratio, which is the ratio of water transpired to dry matter produced up to any point, is due not to any effect on the transpiration rate per unit weight of leaf but to an effect on growth. This effect is such that at any point prior to that of final harvest, the ratio of the amount of dry matter produced after that point, to the amount produced before it, is, in most cases, greater the larger the nitrate supply. The transpiration rate per unit of plant is increased, however, as a result of an increase in leaf weight ratio.