

BOOK REVIEWS

The Physiology and Biochemistry of Drought Resistance in Plants: edited by L. G. PALEG and D. ASPINALL. Academic Press, Sydney, 1981. 492 pp. £46.

The book provides a critical review of the many new facets of plant responses to drought that have come to light in the past 15 years. There are 16 chapters by 24 authors of whom just over half are resident in Australia. The subjects covered range from whole plant physiology to detailed aspects of ultrastructure and cell biochemistry. The underlying difficulties in improving plant growth in areas of uncertain rainfall are brought out in a chapter on mechanisms of drought tolerance by Jones, Turner and Osmond. The most rewarding improvements they consider are obtained with the use of plants which have rapid phenological development. This, however, inevitably leads to depressed yields in years of adequate rainfall. This dilemma highlights the problem of selection for all drought resistant properties where increased yield-stability in relation to rainfall-fluctuations minimizes growth expectations.

The nutritional needs of drought resistant plants and the role of mineral ions in relation to osmoregulation are reviewed in two separate and detailed chapters by Pitman and Borowitzka. Nitrogen fixation is discussed by Janet Sprent who points out that this process is even more sensitive to drought stress than the accumulation of mineral nitrogen. The recognition of two basic types of root nodules namely, those of determinate and indeterminate growth, with the latter showing greater drought resistance, provides a hopeful avenue for further research.

Betaines are extensively discussed in three chapters with only minimal areas of overlap. Wyn-Jones and Storey provide a complete review of the ammonia compounds and discuss whether their formation is a byproduct of the reaction of plants to stress or a positive adaptation to drought. Although they logically argue in favour of the latter, there appears to be no cogent reason as to why both possibilities might not be equally valid. Aspinall and Palesg show the difficulties encountered in attempting to relate proline production to drought resistance. Rapid maturation, low predictable yields and high proline content suit drought conditions, but do so when the growing period is kept to a minimum. In the view of these authors it is still premature to breed for drought resistant plants with high proline accumulation potential.

Chapters by Mansfield and Davies on stomata and by Milborrow on abscisic acid provide an exhaustive review

of considerable breadth on the ability of leaves to restrict water loss in response to drought. Mansfield and Davies examine the ability of stomata to sense changes in atmospheric relative humidity and present this as an adaptive mechanism which allows plants to anticipate subsequent reductions in soil water availability. Milborrow reviews the role of abscisic and phaseic acids as well as that of xanthoxin in controlling water loss from leaves. Such is the lack of comparative data in terrestrial plants that the ecologically extreme case of an aquatic species has to be used to provide an example of a drought-intolerant plant with low concentrations and little fluctuation in abscisic acid content.

Photosynthesis is discussed by Kreidemann and Downton who, in addition to providing a detailed review of the role of C_4 photosynthesis and Crassulacean acid metabolism in relation to drought, develop their chapter to give a searching review of the photosynthetic adjustments that take place with time at both a subcellular and whole leaf level as plants are exposed to continuing drought. Fine control mechanisms and their influence on gas exchange at low r_s values appear to be crucial to maximizing water-use efficiency during early drought and this and other examples justify their case for further study of field-hardened plants as opposed to soft laboratory grown material.

The book as a whole gives a coherent picture of the many aspects of plant physiology and biochemistry that are affected by drought. With the exception of the chapter on protein synthesis by Bewley, most of the examples concern crop plants. Compared with some of the other environmental stresses which beset agriculture, such as frost-damage, chilling-injury and flooding, drought presents a particularly agrarian impasse. In these other stresses nature's response of reducing growth and minimizing metabolism will suit the agronomist in that the plant can be adapted to sit out the stress period. However, this solution is not what is required for arid agriculture. This book clearly illustrates this conflict between natural ecological and evolutionary adaptations in relation to drought and the opposing efforts of many to achieve continued and reliable growth in spite of uncertain rainfall. This thought-provoking book together with its thorough documentation and immense coverage can be warmly recommended to phytochemists and all who are concerned with this immense problem.

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