Vegetation and the Atmosphere

Volume 2
Case Studies

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1. Temperate Cereals

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I. INTRODUCTION

The case studies reported in this chapter have been chosen to fulfil four broad aims: (i) to explore important aspects of whole plant physiology for temperate cereals in the field, and the influence of the physical environment on them; (ii) to illustrate the potentialities of physical methodology for studying plant growth processes; (iii) to provide field data which will allow comparison and extrapolation between controlled and outdoor environments; and (iv) to provide mechanistic or empirical descriptions of the climatology of temperate cereals for use in model analyses or estimating procedures. A particular concern has been to examine physical processes and their related physiological causes or consequences *within* the canopy.

2. Maize and Rice

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I. INTRODUCTION

According to the FAO Production Yearbook, world acreages of rice and maize planted in 1970 were about 136 million and about 111 million hectares, respectively. The world rice output (unhulled) reached 300 million tons and the maize output was about 270 million tons. Most inhabitants of the Far East and south-east Asian countries live on rice and the rice exported from these districts forms about 90% of the world output. Maize, on the other hand, is a source of food for animals as well as for man and about 70% of the world output is produced in North American and Asian countries.

3. Sugar Beet and Potatoes

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I. INTRODUCTION

The micrometeorological and physiological characteristics of sugar beet and potatoes have been investigated by many researchers throughout the world. Most investigations lack the complete set of measurements needed to calculate fluxes of momentum, sensible and latent heat and CO_2, and their dependence on soil- and crop-water relations. There are sufficient observations on these two crops, however, to attempt a complete characterization through a synthesis of the available information.

Sugar beet and potato crops have several common characteristics which may be compared. Both crops canopies are typically 50 to 60 cm tall. Provided the row spacing is 60 cm or closer, the foliage will generally form a complete soil cover by mid-season. Both crops display their leaves at an entire range of angles and have been reported to develop leaf area indexes of six or greater. These factors may lead to similar radiation and aerodynamic

4. Sunflower

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I. INTRODUCTION

Sunflower (*Helianthus annuus* L.) is a plant native to North America. Introduced in Europe in 1596, it is now grown mainly in the USSR, Argentina,

5. Cotton

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I. INTRODUCTION

A. Anatomy, Physiology and Phenology

The two most widely cultivated species of cotton, *Gossypium hirsutum* L. and *G. barbadense* are allopolyploids ($n = 26$) of central and South American origin. The two other commercially grown species, *G. herbaceum* and *G. arboreum*, are diploids ($n = 13$), found in Africa and western and central Asia and in India, south-east Asia and the Far East respectively.

All four cultivated species are perennial or biennial in habit but the crop is normally cultivated as an annual. The growth habit of the cotton plant is complex. Apical meristems, which can give rise to either vegetative (monpodia) or flowering (sympodia) branches, develop in the axil of each cotyledon,

Contribution from the Agricultural Research Organization, Volcani Centre, Bet Dagan, Israel. 1973 Series, No. 170–E.

6. Townsville Stylo (*Stylosanthes humilis* H.B.K.)

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I. INTRODUCTION

Townsville stylo, previously known as Townsville lucerne, is a tropical annual legume, native to central and southern America, and adapted to summer rainfall climates. Since its chance introduction to northern Australia in the early 1900s, Townsville stylo (hereafter contracted to T.S.) has become a well-established alien in tropical Australia. Its early establishment, spread, and general agronomic characteristics have been reviewed by Humphreys (1967). In the mid 1960s it had not been widely exploited and Humphreys concluded that, although the basic agronomic information had been available for some time, the financial structure of the beef industry in northern Australia did not favour large-scale investment in pasture improvement.

Since then, economic conditions became more favourable and the total area sown to T.S. in the Northern Territory rose over the last six years from

7. Coniferous Forest

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I. INTRODUCTION

There have been many descriptive studies of the micrometeorology and environmental physiology of coniferous forests, well summarized in Geiger's (1965) book and in recent reviews by Reifsnyder and Lull (1965) and

8. Deciduous Forests

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This chapter presents the essential characteristics of the micrometeorological regime of deciduous forests. The examples to be cited refer to natural and cultivated forests in the zone of broad-leaved forests (the Moscow region) and in the central forest-steppe of the Russian plain (the Kursk region).

The micrometeorological regime has been defined by complex heat-balance measurements analysed for the following purposes: (1) definition of the upward and downward fluxes of radiation including net radiation above the crown and within the canopy at different levels; (2) definition of the vertical profiles of temperature, air humidity and wind velocity above the crown and within the canopy as well as of the temperature of the surface and upper layers of the soil; (3) definition of the water content in the root zone of the soil and of surface evaporation; (4) specification of structural parameters of the forest stand and of the vertical profile of the leaf and non-leaf surfaces of the forest and grass canopy.

A detailed account of all techniques of measurement and calculation and a full description of the deciduous forests where the measurements were made was presented in a book by Rauner (1972) and the principal results summarized here are taken from this source.

I. ARCHITECTURE OF LEAF CANOPY

The geometrical structure peculiar to a plant canopy determines its interaction with fluxes of energy. This structure, in turn, can be evaluated

9. Carbon Dioxide Exchange and Turbulence in a Costa Rican Tropical Rain Forest

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I. DESCRIPTION OF THE FOREST

In November 1967, micrometeorological measurements were made in a regrowth tropical rain forest near Turrialba, Costa Rica (Lemon *et al.*, 1970; Allen *et al.*, 1972). The objectives were to describe the micro-climate of this forest system and to obtain flux densities of carbon dioxide, water vapour, and sensible heat to or from the forest. Concurrently, Stephens and Waggoner (1970) used leaf chamber techniques to determine the relation between net photosynthesis and light for leaves of several of the species prevalent in the forest.

10. Citrus Orchards

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The objectives of this chapter are threefold. Firstly, a brief outline is given of some of the phenological and macro-climatic features of citrus. Secondly, recent studies on the micro-environment of citrus are reviewed, with particular emphasis on the transfer of radiation, momentum, latent and sensible heat. Finally, the practical importance of micro-climatology is discussed in sections on frost protection in citriculture and on means of controlling the solar radiation climate in citrus orchards.

I. PLANT CHARACTERISTICS AND MACRO-CLIMATIC FEATURES

Citrus is a typical mesophyte, growing in tropical and sub-tropical regions. The genus is characterized by glossy, evergreen leaves without any specialized

11. Swamps

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I. INTRODUCTION

A. Terminology

The word 'swamp' has been applied to the forested Everglades area of Florida, to marshes, bogs, reed fields, and also to Canadian muskeg. These areas differ greatly from each other in the extent to which the water surface

12. Grassland

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Canadian Committee for the International Biological Programme Contribution No. 199.

13. Tundra

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I. INTRODUCTION

Tundra is a term originally used for treeless plateau areas in northern Finland but its meaning has become enlarged to describe the whole of the vegetation zone lying between the northern limit of the boreal forest and the permanent ice caps (Pruitt, 1970); it includes a land area of 6 million km^2 mainly lying above 65° N latitude (Bliss, 1971). Fragmentary areas of tundra are also found on the coast and adjacent islands of Antarctica as well as at high altitudes in all latitudes (Greene and Longton, 1970).