

**Fungal Pathogenicity and the Plant's Response:** edited by R. J. W. BYRDE and C. V. CUTTING. Academic Press, London, 1973. xiv + 500 pp. £8.50.

THIS is a record of the proceedings of the third Long Ashton symposium which was held in Bristol in September 1971. The symposium was concerned with aspects of physiological plant pathology and consisted of 18 papers grouped under two main headings "Fungal Pathogenicity" and "The Plant's Response", together with an inaugural lecture by R. K. S. Wood. The discussions which followed each paper are fully recorded and the closing address is also given.

The inaugural lecture on "Specificity in Plant Disease" reviewed the information currently available on pathotoxins, phytoalexins, wall-degrading enzymes and common antigens in relation to resistance and susceptibility but it was stressed that the actual determinants of pathogenic specificity still remain unidentified. Section I on "Direct Involvement of Fungal Proteins" consisted of three papers of which two dealt with the activities of pectolytic enzymes on potato and apple tissues. Improved techniques such as isoelectric focusing have provided more precise information on the activities of these enzymes which are clearly responsible for cell separation but the direct cause of death of the host protoplasts remains obscure. It was suggested that the plasmodesmata in potato tissue may be involved in the lethal effect. The third paper in the section presented results on the effect of kinetin and pigmented metabolites of *Venturia inaequalis* on spatial distribution of scab lesions on apple shoots and attributed this to hormonal control of host resistance.

Section II (two papers) dealt with "The Involvement of Ethylene". The use of gas chromatography has shown the widespread effects of low concentrations of ethylene on plant metabolism and its production by plant tissue as a general response to stress or injury require that its activities are taken into account in investigating pathogenic situations. The stimulation of ethylene production in cauliflower florets by *Erwinia carotovora* was reported to be brought about by the increase of glucose oxidase activity in the host cell walls by the action of pectate lyase from the bacterium. A general review of the involvement of ethylene in plant disease discussed the source of ethylene in diseased tissues (concluding that the host tissues are the major source), ethylene biosynthesis, ethylene as a cause of symptoms and ethylene in relation to host-pathogen interactions. The examples quoted in the paper provided evidence that ethylene is involved in a variety of ways in host-pathogen relationships.

The four papers in Section III are concerned with "Obligate Parasitism". A paper on the growth of obligate parasites *in vitro* deals with the culture on host tissue cultures and with axenic cultures. Dual cultures provide a useful means of investigating host-parasite relationships of obligate parasites but it was stressed that these relationships may not be typical of whole plants. Despite the recent successful axenic culture of rusts little appears to be known of the essential requirements for their saprophytic growth. The complex penetration process of cabbage root hairs by zoospores of *Plasmidiophora brassicae* is described in a very interesting paper. The speed at which penetration takes place and the host responds by deposition of a papilla is particularly striking. Penetration was apparently mechanical but the possibility of a package of insoluble enzymes at the penetration point was mentioned in the discussion. In the subsequent development of the amoeba in the root hair, the host nuclear response was limited in comparison with the response in gall tissue.

The third paper in this section differs from the general pattern in that E. C. Bracker

and L. E. Littlefield have combined and extended their contributions at the Symposium to produce a review article on "Structural Concepts of Host-Pathogen Interfaces" in which reference is made to host-symbiont and host-parasite associations where appropriate. This is an important paper which provides a comprehensive and up-to-date survey, with 269 references, of a rapidly-developing and important field which is arousing much interest today. The literature is reviewed under the headings Intercellular, Predatory, Intracellular non-haustorial and Intracellular Haustorial relationships. To encourage a consistent approach to the study of interfaces, still largely in the descriptive phase, the authors have defined their terms rigorously and have described a range of interface types which are presented diagrammatically and assigned numbers (IT1-IT46) by which they are referred to in the text. The value of these type descriptions and of the paper as a whole is enhanced by 82 excellent electronmicrographs.

The effect of yellow rust and loose smut of wheat on growth and carbohydrate accumulation and translocation is the last paper in the obligate parasitism section. Growth and translocation patterns were closely correlated but difficult to identify into cause or effect. It was concluded that in yellow rust, the fungus by providing a "sink" diverts the translocate but that in loose smut, at least in the early stages of infection, growth factor changes may be responsible.

Under the second general heading "The Plant's Response", Section IV consists of four papers on "Induced and Performed Resistance Factors". Much of the work in this field continues to be on phytoalexins, using the term for inhibitory compounds which accumulate after infection though they may be present at lower concentrations in healthy tissues. Interest now centres on the factors stimulating their production and on their role in host-pathogen relationships. In fungal infections of *Phaseolus*, phaseollin accumulation was shown to be closely related to cell browning and death and its production was interpreted as part of the general metabolic change brought about by necrosis. Physiologic races of *Colletotrichum lindemuthianum* did not differ in their sensitivity to phaseollin and their ability to infect depended on whether or not they caused a hypersensitive reaction and rapid necrosis. Studies on fourteen legumes showed that most reacted to infection by production of a variety of phenolic compounds, some inhibitory to spore germination, and that performed inhibitors were present in chickpea and groundnut. Another paper described experiments on apple canker which showed that the resistance of immature fruit to *Nectria galligena* could be attributed to accumulation of benzoic acid. The ability of apple tissues to produce benzoic acid depended on their maturity, inoculum concentration and the concentration of carbon dioxide in the storage atmosphere. In investigations on resistance of potato tissues to *Phytophthora infestans*, it was found that there was an association between the hypersensitive response and lignification and, to some extent, with phenylalanine lyase activity. It was suggested that lignin could act as a mechanical barrier or chemically, possibly by interfering with the activity of fungal galactanase.

Section V (four papers) dealt with "Altered metabolism". A paper on changes in enzymes of host and pathogen, with special reference to peroxidase interaction quoted abundant evidence for increases in and changes in the isoenzyme patterns of peroxidase and other enzymes following virus, bacterial and fungal infection. In some cases ethylene appeared to be the inducing agent. Host resistance was shown to be related to peroxidase activity. It was suggested that peroxidase may influence the DNA and RNA regulation of host metabolism by its action on histones. In studies on *Fusarium* wilt of tomatoes, most of the increase in pectinmethylesterase content in infected plants was of host origin. Content

of  $\alpha$ -tomatine increased following infection but this compound, despite its fungitoxicity, could not be implicated in varietal host resistance as it was present in similar amounts in resistant and susceptible varieties. Studies of great interest with regard to the mechanism of pathogen specificity on tomato leaf-mould showed that avirulence of physiologic races of *Cladosporium fulvum* were associated with their ability to produce in culture materials (thought to be proteins) selectively toxic to different host-genotypes, as indicated by their effect on permeability of host cell membranes. The final paper on the role of lysosomal enzymes in pathogenicity indicated that the lysosome system is associated with soft-rot disease in plants and that improved techniques will probably show that this association extends to other types of plant disease.

Taken as a whole, the report provides a valuable survey of the state of knowledge at the time of the symposium on the chosen topics in physiological plant pathology, in all of which rapid advances are being made. Much of the information presented is available elsewhere in journals but the combination of the papers, their usually extensive reference lists and the discussion reports together make this a convenient source for this information and is also useful in indicating new lines of work which might profitably be undertaken. The book is excellently edited and produced. Typographical errors are very few—only three were noted. One minor criticism concerns the discussion reports which could have been more vigorously edited to remove inessentials; verbatim records, while creating an aura of authenticity, make for rather tedious reading.

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