PLANT PATHOLOGY

Fireblight Breaks Out

from our Botany Correspondent

THE Ministry of Agriculture's announcement, on August 29, of thirty-seven recent outbreaks of fireblight in Kentish orchards should give added incentive to the hard working plant pathologists at East Malling Research Station. Research on fireblight began at East Malling in 1957, when an unknown disease of pears was observed in some Kentish orchards in the late summer of that year. Later work in collaboration with the National Agricultural Advisory Service and the Plant Pathology Laboratory at Harpenden confirmed that the symptoms of wilting and blackened flowers and leaves were those of fireblight. Research on the disease and the pathogen, the bacteria *Erwinia amylovora*, then began.

While an eradication policy was in force—an unsuccessful attempt to wipe out the disease by burning every infected plant—field experiments were not possible. But when it became obvious that fireblight had become permanently established, research was intensified once more.

Dr J. E. Crosse, who is in charge of the bacterial work at East Malling, has just completed a year at the University of Missouri working with Dr P. N. Goodman on various aspects of the fireblight problem. Meanwhile at East Malling work has continued on the disease, particularly in apples. The principal features of an outbreak of infection in Suffolk in 1968 were compared with those of similar outbreaks in North Kent in 1969. Certain meteorological conditions were common to both years, although the general pattern of weather seemed to have been different. In both years the disease was seen first in late July or early August, and infection was common in nearby hawthorn hedges.

In the winter of 1968–69, work began on aspects of overwintering of the pathogen, and results so far suggest that it will survive in Britain in infected shoots of both hawthorn and apple until apple blossom time, as well as in cankers in more mature wood. Other work in progress includes a search for differences between pear, apple and hawthorn strains of *Erwinia amylovora*. The recent severe infections in apples had suggested that a new strain, particularly virulent in apples, may have appeared. Although there are arguments against this it remains a possibility, and work which started early in 1968 on methods for differentiating strains is being continued.

So far conventional biochemical and phage sensitivity tests have failed to distinguish between isolates from different hosts, contrary to experience with some other plant pathogenic bacteria. Other methods are being pursued.

Further work on fireblight is concerned with the types and properties of bacteria colonizing the surfaces of fruit trees and their possible interaction with *Erwinia amylovora*. Because of the difficulty which has been experienced in the chemical control of this and other bacterial plant diseases, a programme of breeding pears for resistance to fireblight was started two years ago. Breeding experiments take a long time and so it will be some time before any useful strains are produced. Meanwhile farmers will have to continue to deal with fireblight by cutting out all infected growth, or completely destroying trees that are very badly infected.

PHLOEM TRANSPORT

Doubt about Mass Flow

from our Plant Physiology Correspondent

THE mass flow hypothesis of phloem translocation proposed originally by Münch in 1926 is still frequently considered to be the best single explanation of long distance nutrient transport in the plant, in spite of the appearance of numerous sophisticated alternative theories in the intervening years. Perhaps a basic reason for this is the extreme difficulty of obtaining unequivocal evidence to support any explanation of this most intractable of experimental problems.

The principle of mass flow is simply the movement of solution along a turgor pressure gradient. If the permeability of a phloem element is greater longitudinally than it is laterally, and if there is a source of osmotic pressure at one end of the phloem and a sink at the opposite end, then some form of mass flow must operate. Energy would be required to maintain the osmotic gradient between the ends of the system, but otherwise the movement would be independent of metabolism. The major alternatives to the mass flow hypothesis are the electrokinetic mechanism proposed by D. S. Fensom (*Canad. J. Bot.*, **35**, 573; 1957) and by D. C. Spanner (*J. Exp. Bot.*, **9**, 332; 1958) and the cytoplasmic pumping theory developed by R. Thaine (*Nature*, **222**, 873; 1969). An important question is whether or not there is a flow of solution in the sieve tubes of the phloem. On balance the evidence from exudation experiments suggests that such a flow does occur. Peel, Field, Coulson and Gardner have, however, used the aphid stylet technique to obtain results which indicate that translocation of nutrients may not be the result of mass flow in the sieve tubes (*Physiol. Plant.*, **22**, 768; 1969).

The aphid stylet technique, developed by Kennedy and Mittler (*Nature*, **171**, 528; 1953), makes it possible to monitor continuously the substances moving through a single phloem sieve tube. Aphids are allowed to feed from bark tissues and when their stylets are embedded in the phloem cells the insects are anaesthetized and the stylets severed at their bases. Exudate from the phloem can be collected from the cut ends of the stylets and the contents analysed.

In the latest study, Field *et al.* used stylets of the aphid *Tuberolachnus salignus* to monitor the phloem in strips of willow bark (*Salix viminalis*). The stylets were embedded a short distance from a polythene reservoir clamped to the strip of bark. This reservoir was filled with a solution of sugars labelled with ^{14}C and phosphates labelled with ^{32}P in tritiated water. It is known that the exudate from the stylets accurately represents the contents of the punctured sieve tube, and therefore the movement of the labelled solutes could be determined relative to the movement of the tritiated solvent. The surprising result was that although substantial amounts of both sugar and phosphate could be detected in the stylet exudate after comparatively short times, there was little or no evidence for the movement of tritiated water, even