The first Minnesota trials were set up in 1953 and successive experiments followed in 1957, 1959 and 1965. It was typical to find rapid development of wilting symptoms in inoculated pin oaks (more than 70 per cent in 5 weeks) and a subsequent high mortality rate (91 per cent at the end of the first year). Wilt inoculation was superior to chemical treatment or mechanical clearing. Whereas most inoculated pin and bur oaks were dead within a year, 50 : 50 mixtures of 2,4-D and 2,4,5-T killed less than 10 per cent of the trees and, even though treatment with 2,4,5-T produced an 80 per cent killing, the residual leaf canopy was too dense to allow for good pine growth. Areas cleared by bulldozing were quickly recolonized by oak sprouts. A cost of 1 to 2 cents per killed system for the wilt application was very competitive compared with other methods, and there was very little dissemination of the wilt.

If, then, we wish to eradicate oak, these are portentous findings. But the development of such a fungal silvicide, indeed of any biological control agent, should proceed with great caution. French and Schroeder aptly conclude their article by drawing attention to the dangers of introducing a virulent pathogen such as *Ceratocystis* and of extrapolating carefully controlled plot trials to other situations. They argue that this control procedure should be considered only for areas where the fungus is endemic and where the oaks are of little or no value (commercial value being assumed). But even in Minnesota, wilt had extensively killed oaks with the serious loss of shade and forest trees. Promising though the approach appears, much remains to be known before its adoption is recommended. What is the outcome of building up a massive local reservoir of the pathogen, for example ? It is to be hoped that the regulations for the use of microbiological pesticides will be at least as stringent as those governing the application of chemical agents.

AGRICULTURE

Grow Better Crops

BOTH scientists and farmers agree that British crop yields are only half what they might be. This was the major theme to emerge from a symposium on potential crop production in Britain, held at the University College of Wales, Aberystwyth, last week. It brought together scientists working on fundamental aspects of plant growth and agriculturists concerned with the types of farming applicable to different parts of Britain.

As G. Thorne and D. J. Watson (Rothamsted Experimental Station) pointed out, the useful parts of major British arable crops—cereals, potatoes and sugar beet—are composed almost entirely of carbohydrate and water, so arable crops can be regarded as machines for converting carbon dioxide and water into carbohydrate using the Sun's energy. The present yields represent less than 3 per cent conversion of the available radiation whereas the theoretical maximum is 18 per cent, so that there is plenty of potential for improving yield. It is not practicable to increase carbon dioxide and light artificially in the field, but the water balance can be affected by irrigation. The role of water, H. L. Penman (Rothamsted) said, is to provide the right environment for the roots that will ensure maximum availability of nutrients and maximum efficiency of photosynthesis in the leaves. In a well drained soil this environment exists for a range of water content which is quantified by the term "limiting deficit". This is used in the interpretation of field results and as the basis of advice on when to irrigate and how much to apply. When the soil water content is maintained within this range crop yields are limited by other factors and water content cannot be used to make good some other defect in management; the better the management, the better the return from judicious irrigation.

Several speakers showed that despite the long growing season in Britain, the period when the mean temperature is above 42° F, temperature plays a dominant part in the pattern of plant growth. The slow rise in the spring which fails to keep pace with the enormous incoming radiation means that plants are slow to get away and often only reach their maximum photosynthetic capability—that is, maximum leaf area index—some weeks after radiation levels have begun to decline. This problem is accentuated in northern climates and by high altitudes. It is therefore important to try to increase leaf area indices earlier in the year. For cereals, longer survival of individual leaves would be valuable, for cereal grains only start to accumulate carbohydrate at anthesis when the leaf area index has reached its maximum. Thorne and Watson pointed out that greater maximum leaf area indices are unlikely to increase yield much unless the arrangement of the leaves can be changed so that light penetrates deeper into the canopy.

There have been attempts to breed Mediterranean races of perennial rye grass with these characteristics. These races are markedly different from northern races in their ability to continue active growth at low temperatures. But, as J. P. Cooper (Welsh Plant Breeding Station) remarked, this ability is linked to low frost resistance. Norwegian races can adapt much better to a sudden rise in temperature and produce a larger increase in the photosynthetic rate. The adaptation to low temperature seems to be related to enzyme concentration. Norwegian races are thought to produce more enzyme at low temperatures. They have smaller leaves than the Mediterranean races and a greater protein content per unit leaf area. More basic research is needed into the possibility of increasing overall protein contents.

Professor P. F. Wareing (University College of Wales, Aberystwyth) stressed that more intensive effort is needed on problems connected with the selection and breeding of crops able to grow at low temperatures. There are two aspects to be considered—photosynthetic ability at low temperatures and active cell division—both of which are controlled at the molecular level. We know little of the mechanisms involved, but, once understood, there is the possibility that chemical treatments might be used to promote growth at low temperatures.

The demands from the processing industry for uniform products and stability of yield under the stress of adverse weather conditions are bound to have an effect on the way research goes. The growing trend towards more intensive systems will need a more critical approach by research workers of all aspects of agricultural development and processes and, as Mr Emrys Jones said, we separate research, development and application at our peril.