Photosynthesis —
Life's energy pipeline

The trapping of solar energy by green plants to form organic compounds is carried out more efficiently in some species than in others. Scientists at NRC's Prairie Regional Laboratory are now examining the process in more detail, particularly as it relates to nitrogen fixation.

"What drives life is . . . a little electric current, kept up by the sunshine." So said biochemist Albert Szent-Gyorgi in describing the dominant chemical process on earth — photosynthesis. The electric circuit referred to by the Nobel laureate scientist is found in the cells of green plants. By chemical reactions still only partly understood, electrons in the pigment chlorophyll are "pulsed" by sunlight up to high energy levels, leading to the creation of the chemicals that drive all of life's myriad processes. The second, synthetic aspect involves the cell's use of these high energy chemicals to "fix" carbon dioxide gas from the atmosphere with water vapor to produce glucose sugar and oxygen. And glucose is the common currency in the energy trading system of life, the universal fuel.

While scientists are still not sure if plants vary in their ability to carry out this first photochemical process, they know for certain that there are a range of efficiencies when it comes to the second part, the assimilation of carbon dioxide. Plants like corn and sugar cane which show the highest efficiencies differ from most other species in a very important respect — the losses they suffer through daytime respiration are minimal (plants, like animals, must breathe). It is the carbon dioxide gain then, the difference between what is fixed and what is lost via respiration, that sets the photosynthetic efficiency. (Plants which minimize carbon dioxide loss through "photorespiration" are called C_4 types, while the less efficient types are called C_3, a reference to the way they assimilate the gas.)

Because photosynthesis drives all plant physiological processes and provides virtually all of its building material (over 90 per cent of a plant's dry weight is fixed carbon dioxide), scientists are now looking at the possibilities of improving a crop's photosynthetic ability by current plant breeding methods. At PRL, two scientists, Dr.

Bruce Kane, PIB/DIP

The root system of a field pea plant, showing the nodules responsible for nitrogen fixation. These swellings are root cells that contain Rhizobial bacteria in "walled off" structures where they are able to convert the nitrogen of the atmosphere into a form available to the plant. Besides providing the anaerobic or oxygen-free environment, the plant supplies "trigger" substances that initiate the fixation process. PRL scientists are leaders in the quest to understand the biochemical nature of this unusual plant-bacteria association.

Les racines d'un pied de pois des champs montrant les nodosités responsables de la fixation de l'azote. Ces protubérances sont formées de cellules radiculaires contenant des bactéries rhizobiales dans des structures murées où elles peuvent donner à l'azote atmosphérique une forme que la plante peut utiliser. En plus de réaliser cet environnement anaérobie ou exempt d'oxygène, la plante fournit également des substances qui déclenchent le processus de fixation. Les chercheurs du LRP sont à la pointe de l'effort scientifique visant la compréhension de la nature biochimique de cette association inhabituelle entre une plante et des bactéries.