Botany

What makes roots grow down?

Exactly what makes roots grown down toward the earth, and shoots reach up toward the sun? Plant physiologists have been working on this question for a long time, and do have some understanding. Now, two Danish researchers have added a little more. Hamed M. M. El-Antably and Poul Larsen of the University of Aarhus in Denmark report in the July 5 NATURE that gibberellins, cell-elongating plant hormones, definitely play a role in the downward growth behavior (geotropism) of roots. Auxins, plant growth-stimulating hormones, are already known to play a role.

Using *Vicia faba*, the broad bean, they grew some shallow horizontal roots, and some deeper, vertical roots. They split the roots lengthwise, thus obtaining upper and lower halves (from the horizontal roots) and right and left halves (from the vertical roots.) Analysis for gibberellins showed that about the same amount is present in right and left halves, but more is present in upper halves than in any of the others.

What this means, translated into plant behavior, is that as roots begin to grow out horizontally from the young plant, cell-elongating gibberellins accumulate in the upper portions of each root. These upper cells are stimulated to elongate faster than the lower cells, thus causing the root to bend downward and grow toward the earth. After the "bend" is made and the root is growing vertically, gibberellin levels even out and cells on both sides elongate at the same rate. The root then grows vertically throughout plant maturity.

The question remains, why does gibberellin stimulate the upper portions but not the lower? The team says an elongation inhibitor may accumulate in the lower portions, and they are studying that problem now.

The key to rhizobia's secret

Nitrogen-fixing soil bacteria are some of the handiest little beasts around. In combination with the living roots of leguminous plants, members of the genus *Rhizobium* form nodules and turn atmospheric nitrogen into a form useful for building plant proteins. The problem is that they are picky about their habitats—those strains that will inhabit soybeans will not live in symbiosis with clover or garden beans or alfalfa. And rhizobia have an unfortunate aversion to nonleguminous plants. They withhold their protein-boosting talents from deserving plants such as corn and wheat, and from starving people.

Microbiologists and botanists are studying *Rhizobium* to determine what causes the bacteria's specificity, and how it can be turned off. Two researchers from the University of Minnesota at Minneapolis, B. B. Bohlool and Edwin L. Schmidt, may have found the answer, they report in the July 19 SCIENCE.

They studied lectin, a plant protein that binds specifically to the saccharides on the surfaces of cells. They bound soybean seed lectin with a fluorescent dye, then stained several rhizobia species and strains with the mixture. Using fluorescent microscope technique, they were able to observe binding of the lectin with the cells. The lectins may present a site on the root surface, they say, that interacts with a certain polysaccharide on the surface of a specific bacterial cell. This interaction then could lead to the beneficial symbiotic relationship.

If this recognition system can be controlled, *Rhizobium* may learn to live with a wide variety of plants.

Biomedicine

Hypothalamic factors and behavior

Tucked away in the dark recesses of the human skull is the cluster of cells known as the hypothalamus. Chemicals secreted by the hypothalamus serve as an executive switchboard for hormones that act throughout the body. Evidence is now building that the hypothalamic factors (hormones) may also affect mood and behavior by acting outside the hypothalamus in other regions of the brain.

Luteinizing hormone-releasing hormone (LH-RH) is known to affect reproductive behavior in animals. Melanocyte-inhibiting factor (MIF) and thyrotropin-releasing hormone (TRH) are known to influence mood and behavior in both animals and people. Now Andrew Winokur and R. D. Utiger of the University of Pennsylvania School of Medicine report in the July 19 SCIENCE that only one-third of TRH is in the hypothalamus. The other two-thirds of TRH is outside, notably in the forebrain, posterior diencephalon, brain stem and posterior cortex.

This finding suggests that the TRH in the hypothalamus acts like a normal hypothalamic factor—exerting control over hormones acting on the thyroid—but that the TRH outside the hypothalamus is up to some other kind of activity. Influencing mood and behavior perhaps? The areas where TRH act are rich in norepinephrine and serotonin, and these nerve transmitters are known to be heavily involved in mood and behavioral changes.

Fetal protein suppresses tumors

Alpha-Foetoprotein (AFP) is a sugar protein synthesized by the fetal liver. AFP's role in the fetus is unknown, but increased levels of AFP in the blood of adults means either they are pregnant or have cancer. Now Gerald J. Mizejewski and Roblee P. Allen of the University of South Carolina report in the July 5 NATURE that antobodies made against AFP can suppress tumors.

The biologists took AFP from mouse amniotic fluid and injected it into rabbits. The rabbits made an antiserum (antibodies) against AFP. The biologists then injected the antiserum into mice with AFP-secreting tumors. The antiserum reduced the size of the tumors by 32 percent, compared with tumors of control mice. The antibodies also switched off the tumors' AFP secretion. The biologists then tested the antiserum on mouse tumor cells. They found that the antiserum killed 100 percent of the cells.

These results indicate that "humoral [antibody] immunotherapy was effective against a progressively growing solid tumor."

Biological molecules on the spin

Scientists at Harvard Medical School, the Massachusetts Institute of Technology and associated hospitals will soon be able to study proteins, nucleic acids and other crucial biological molecules as they naturally function—in solution. The reason is that biophysicists at MIT and biological chemists at Harvard are devising a super instrument called an ultra-high frequency nuclear magnetic resonance spectrometer.

The instrument will enable investigators to study the magnetic fields of the spinning nuclei of atoms in biological molecules. It will use an 85,000-gauss superconducting magnetic system and be capable of detecting protein resonance at a frequency of 360 megahertz. It will also allow the study of biologically vital, but magnetically weak, nuclei, such as those of carbon, nitrogen and phosphorus atoms.