This Week in Science

Editorial

941 Opportunities in Agricultural Research

Letters


News & Comment


957 Information Decontrol Urged

958 Neglected Neurotoxicants

Research News

959 Fast, Cheap, and Out of Control

962 Biotechnology Takes Root in the Third World ■ Growing Crops in Saltwater

964 Briefings: Drugs and Biotechnology ■ Climate Experts Say It Again: Greenhouse Is Real ■ Baltimore Assembles Team ■ EARTHWINDS Around the World ■ Science for Non-science Majors ■ DOE Fills Biology Post ■ Citation Impact on the Coast ■ A Sailing Race to Mars? ■ Finland to Join CERN

Articles

969 The Superswell and Mantle Dynamics Beneath the South Pacific: M. K. McNutt and A. V. Judge


Research Article


Reports


Ultradeep (Greater Than 300 Kilometers), Ultramafic Upper Mantle Xenoliths: S. E. Haggerty and V. Sautter

Increase in the Stratospheric Background Sulfuric Acid Aerosol Mass in the Past 10 Years: D. J. Hofmann

Faults in the Mojave Desert, California, as Revealed on Enhanced Landsat Images: J. P. Ford, R. K. Dokka, R. E. Crippen, R. G. Blom


Blocking of the Initiation-to-Elongation Transition by a Transdominant RNA Polymerase Mutation: M. Kashiwagi, J. Lee, K. Zalevskaya, V. Nikiforov, A. Goldfarb


A Novel Nucleoprotein Complex at a Replication Origin: M. Serrano, M. Salas, J. M. Hermoso

Shared Human T Cell Receptor Vβ Usage to Immunodominant Regions of Myelin Basic Protein: K. W. Wucherpfennig, K. Ota, N. Endo, J. G. Seidman, A. Rosenzweig, H. L. Weiner, D. A. Hafler


Book Reviews

Technical Workers in an Advanced Society, reviewed by P. Meikins
Marmots, G. R. Michener
Ecology and Natural History of Tropical Bees, M. L. Winston
Electric Fields in Vertebrate Repair, A. E. Sowers
Books Received

Products & Materials

Agarose for Pulsed-Field Electrophoresis
Growth Factor Monoclonal Antibodies
Genomic DNA Isolation Kit
Automated Separation of Proteins
Vertical Tube Gel Apparatus
PC Integrators for HPLC
Literature
Opportunities in Agricultural Research

Research activity in agriculture is destined to be fostered by a conjunction of factors. The new farm legislation will change provisions of the existing laws that have subsidized monoculture of major crops. The new legislation will increase funds for competitive agricultural research grants. Societal pressures aimed at reducing pollution due to excessive use of pesticides and fertilizers is mounting. Increasing use of no-tillage agriculture reduces soil erosion, but it may lead to additional severity of plant diseases. Continuing advances in molecular biology have created important tools for research in pure and applied plant biology. Of particular significance are the possibilities of improving plant defense mechanisms against predators and diseases.

Insertion of certain genes into plant genomes improves resistance to insects and diseases. Because damage to plants above the soil line is visible, attention has tended to focus on it. Less attention has been accorded invisible damage that affects the health of plants, including their roots, roosters, and root hairs.

A dramatic example of the deleterious effects of soil microorganisms involves strawberries. When virus-free plants were grown from meristem culture in a fumigated soil, yields were three to four times the usual ones. The cost of fumigating soils devoted to major field crops is excessive, but experimental fumigation procedures inform us that plant soil pathogens are responsible for substantial reductions in yields. When diseases and pests are eliminated by experimental treatments, yields in field trials are sometimes improved 50 to 100%.

When monoculture is practiced, yields tend to decrease with time regardless of the amount of fertilizer applied. A steady annual presence of a particular root system favors a few organisms—bacteria, fungi, nematodes—that are pathogenic to plant roots. Changing to a different crop alters the circumstance, and all but the most unspecialized pathogens are unable to thrive in the absence of their usual hosts.

R. James Cook and collaborators at Washington State University have made extensive studies of monoculture of wheat. This crop is grown in eastern Washington under conditions ranging from sparse moisture to irrigation. Through studies with the use of fumigated soil, they have demonstrated a large role for the soil-borne fungi Gaunemannyces graminis, Rhizoctonia solani, and Pythium spp. Gaunemannyces graminis causes take-all, the most importantly important root disease of wheat worldwide. Effects of the root-infecting fungi diminish with crop rotation. After 2 years of growth of other crops, yields of wheat crop those attainable in fumigated soil. Investigations in the state of Washington also showed that G. graminis can be controlled by strains of fluorescent Pseudomonas species. Some of the best strains produce phenazine-type antibiotics that are strong inhibitors of G. graminis. The genes responsible for creating these antibiotics are being isolated. In principle, other genes for producing antibiotics to plant enemies will also be isolated and incorporated in microorganisms associated with plant roots. Cook and collaborators have noted that the health of wheat can be impaired by applying too much nitrogen fertilizer. In regions where moisture is limited, the stimulus of the fertilizer leads to excessive foliation and in turn to excessive transpiration. The resultant stress on the plants makes them susceptible to pathogens and leads to reduced yields.

In the warfare that goes on underground, not all fungi are enemies of plants. Some of the more beneficial plant-microbe associations include mycorrhizal fungi that help plants take in their nutrients and water while providing some protection against root disease. Some fungi establish themselves inside plant tissues and produce substances that inhibit or are obnoxious to insect pests. Other root-colonizing microorganisms inhibit or displace pathogens at the root-soil interface.

What happens to a crop in any given place is dependent on local conditions, including soil and moisture. The variables are many, however, with a combination of traditional and modern scientific approaches, substantial improvements in agriculture are possible. The use of recombinant DNA techniques and polymerase chain reactions is applicable to both the plants and to their associated microflora. Enough progress has already been made to justify optimism. Even if new plant enemies ultimately evolve, human ingenuity will deal with the circumstances.—PHILIP H. ABELSON