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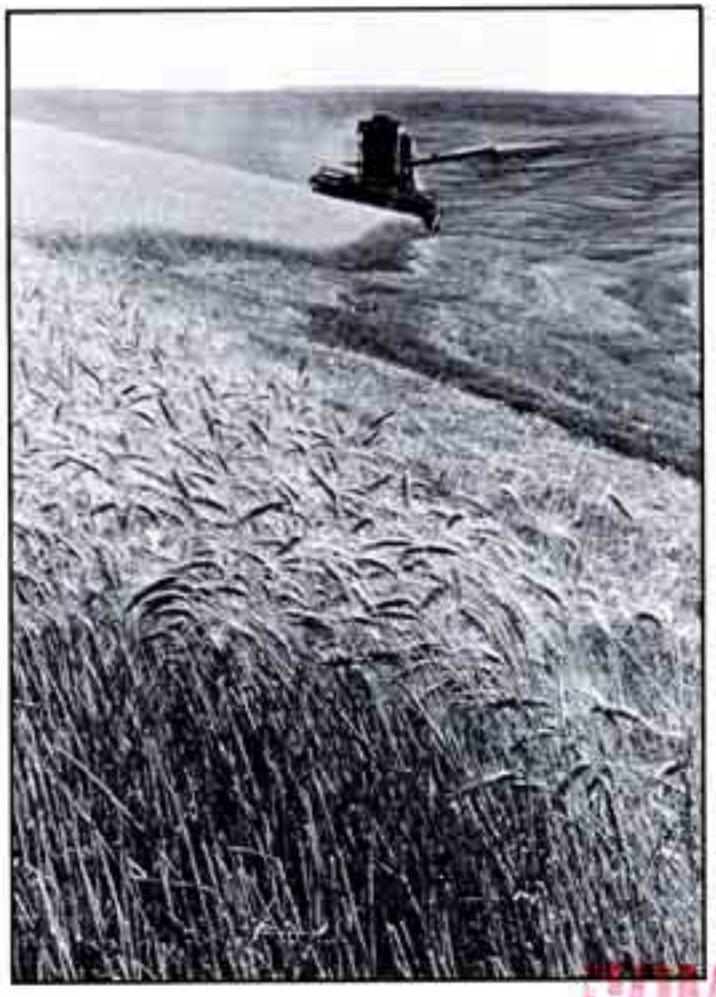

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Managing Editor
Deborah Strauss

Assistant Editor
Dorothy Aukofer MacEoin

Contributing Editor
Pam Johannsen

Editorial and Business Office: DIVERSITY, 1600 South Eads, #404 North, Arlington, VA 22202; phone (703) 486-1606.
Mailing address: PO Box 2160, Arlington, VA 22202-0160.

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CAPITOL VIEWS

Furor Erupts Over Crop Application of Genetic Engineering Technique

A lawsuit precipitated by an experiment set to test whether a potato crop can be protected from frost damage with bacteria whose ice nucleation genes have been removed by genetic engineering techniques has escalated debate over how genetic engineering should be regulated.

Although this first environmental release of genetically engineered bacteria has temporarily been put on hold, controversy about the experiment continues to mount.

The lawsuit was filed in mid-September by Washington writer Jeremy Rifkin and a number of environmental protection groups who argued that the National Institutes of Health (NIH) illegally omitted preparation of an Environmental Impact Statement prior to approving the experiment in June upon the recommendation of NIH's Recombinant DNA Advisory Committee (RAC).

The plaintiffs also challenged the adequacy of the technical advice underlying the approval decision, alleging an absence of ecological experts on the RAC and within NIH itself.

Investigators Steven Lindow and several colleagues at the University of California (Berkeley) had urged approval of the experiment in order to compare the effectiveness of genetically engineered mutants of *Pseudomonas syringae pv. syrinage* and *Erwinia Herbicola* vis-a-vis chemically altered bacteria. With significant input from consultant Anne Vidaver, University of Nebraska, the RAC gave its unanimous approval to the proposal in April. Additional support came from USDA, whose own Recombinant DNA Advisory Committee reviewed and approved the experiment. Members of both bodies concluded that the final proposal satisfied the additional concerns that had been raised and posed no threat to the public and the environment.

The Rifkin lawsuit, coupled with the onset of temperature in northern California too low to permit the experiment, have led the university to postpone the effort, at least until next spring. As for the legal response to the challenge to NIH's procedures and rulings, the government's answer was expected by November 14th.

Safety: The Major Concern

An earlier taste of the renewed debate in Washington and around the country was provided last June by a congressional hearing on regulation of the emerging genetic engineering industry. At the core lies an argument about safety, with Rifkin and a number of noted scientists demanding much more intensive interdisciplinary risk assessment activity before manmade organisms are released outside the laboratory.

Such debate had flared initially in the early and mid 1970's when the first genetic engineering experiments were proceeding in strictly contained settings. Over the next several years an elaborate oversight process, managed by NIH and involving the application of extensive guidelines, appeared to calm much if not all the initial anxiety.

But now the fire has clearly been rekindled, both by recent relaxations of federal restrictions on gene splicing experiments and by the Lindlow and other proposed experiments, some already approved, that involve the release of new genetic material outside the laboratory.

The lawsuit and the hearing are not the only manifestations of concern. New regulatory proposals have been surfacing, ranging from enactment to more stringent enforcement of already existing statues under the purview of the Environmental Protection Agency and the Department of Agriculture. The report of the two subcommittees that held the June hearing is expected to appear in early December and set the stage for further public discussion.

National Plant Germplasm System Capability Critical To Future Agricultural Gains, Experts Tell USDA

Domestic food security necessitates that we strengthen the U.S. National Plant Germplasm System (NPGS) and establish closer links to research activities in genetic engineering of plants, the National Agricultural Research and Extension Users Advisory Board (UAB) told the Secretary of Agriculture in a recent hard-hitting report on the "continued decline in quality and stature of the USDA-supported agricultural research system" (see story, page 4).

Biotechnical Research Priorities

The 1983 UAB report to the Secretary of Agriculture on research policy focused on biotechnical research program areas the Board believes are receiving inadequate attention. The detailed analysis identified crop germplasm conservation as one of seven critical biotechnical research areas the Board designates as priorities if the U.S. is to increase agricultural productivity and efficiency by the year 2000.

The inexactitude of the science of germplasm conservation, the lack of capacity to preserve every living thing, and continued differences of opinion over what priorities should be designated and what efforts constitute adequate resource conservation-all of these issues are creating dilemmas for germplasm scientists that must be resolved, asserts the UAB report.

International Perspective Required

Because access to greater genetic variability is vital to crop breeding programs in every country, the UAB says germplasm collection, conservation, and evaluation activities require both national and international perspectives and programs. Despite the improved and expandedglobal efforts toward systematic conservation of plant genetic resources since the establishment of the International Board for Plant Genetic Resources (IBPGR) in 1974, the UAB says critical components remaining to be resolved include:

- coordination of activities among participating agricultural research institutions.
- development of a common plant genetic information network,
- expansion of the species number in germplasm banks, and
- improvement of systems for germplasm exchange.

The U.S. National Plant Germplasm System must be strengthened in similar ways, according to the UAB report. and must address the following issues in terms of U.S. interests and security:

- improve the system within a clearly-defined national program and plan,
- implement fully the operation of the Germplasm Resources Information Network (GRIN),
- accelerate germplasm evaluation activities especially in collaboration with the private sector,
- expand acquisition of valuable germplasm resources,
- assist in the development of a global system in which access to materials is assured,
- expand research in germplasm conservation, and
- establish closer links to research activities in the genetic engineering of plants.

"It is our position," the UAB reported to the Secretary, "that ARS needs to define its unique role within a national system, as it must within the global system, since the task of germplasm conservation will surely expand in the future."

The UAB acknowledged the FY 1983 increase in the ARS budget for germplasm activity, but said additional funds may be needed to effectively fulfill the NPGS mandate. Before recommending specific increases, however. the UAB proposes that ARS "examine critically the existing activities identified as germplasm evaluation and determine whether some

(Continued on p. 6)

Block Warned Traditional Agricultural Research System "In Peril"

The technological advances essential for American agriculture to remain competitive at home and abroad are not forthcoming from our traditional public-supported agricultural research system, according to the 1983 report from the Users Advisory Board (UAB) to Secretary of Agriculture John R. Block.

The Agricultural Research Service (ARS) and State Agriculture Experiment State (SAES) system is "in peril," warned the high-level advisory board, and without proper funding and necessary internal reforms "will become increasingly irrelevant to the type of technology-intensive agriculture that is likely to emerge in the decade ahead."

In its 1983 report to Secretary Block, the UAB, an appointed 25-member board representing the multiple interests of all users of the national agricultural science and education system, stressed the "grave concern" of its members over the increasing support for agricultural research through competitive funds granted by non-USDA agencies such as the National Science Foundation and the Department of Energy. According to the report, $629.3 million was spent by other federal agencies on agricultural research in FY 1981 in addition to the $810 million spent by USDA.

Comparing this to the situation 30 years ago, when 90 percent of the federal support for agricultural research was appropriated for USDA. the Board concluded: "A fundamental shift [has occured] in the capacity to conduct frontier agricultural research from the time-honored ARS/SAES system to a handful of SAES and private universities with the scientific expertise and equipment necessary to stimulate scientific discovery."

Declines in Funding, Expertise and Laboratories Cited

In addition to the decline of federal funds for our traditional agricultural research system, the 63-page report cites a responding decline in both scientific expertise and laboratory capabilities serving that system. These declines represent "the greatest obstacle to restoring preeminence to the USDA research system" Two related pheonomenon identified by the Board are the increasing average age of scientists with the USDA system, and the significant outlays by the private sector-in comparison to the public sector-in establishing sophisticated biochemical laboratories that work in tandem with product development laboratories.

As most fundamental techniques of genetic engineering are of very recent origin, it may be unrealistic, says the UAB, to expect scientists who graduated from universities in the 1950's to be able to operate on the frontiers of biotechnological research. The UAB also observes that federal agricultural research facilities "continue to be built more in response to political pressure than to scientific needs." Consequently, the system includes too many units-many located too remotely from academic centers from which to attract top talent-with inadequate funding for high-technology equipment.

The report asserts that integrated. interdisciplinary research is an essential ingredient to harnessing recent biological advances for agriculture and says such an approach will require changes in attitudes, institutional relationships. and funding to transform these basic breakthroughs into technologies that can be effectively adapted by farm producers.

"The agricultural research practitioner must he brought together with the knowledgeable cell biologist in an atmosphere of mutual understanding."

To accomplish this, the Board says, "mechanisms [must be developed] to force direct collaboration. The agricultural research practitioner must be brought together with the knowledgeable cell biologist in an atmosphere of mutual understanding."

Research Tax Recommended to Bolster Scientific Expertise

To attract students to basic agriculture, the UAB recommends that USDA offer competitive grants at the institution of the student's choice under the cooperative guidance of prominent basic scientists linked with ARS and SAES researchers in the approved basic plant and animal sciences.

The UAB proposes that this program be funded through assessing a one percent tax on all USDA research and extension appropriations to provide approximately $10 million in revenues annually.

In view of the "agroindustrial sector's pivotal position" in biotechnology and the private sector's reliance on the public sector as the trainer of scientific expertise, the UAB proposes agroindustrial support of endowed chairs within our land-grant colleges. The UAB envisions such funds be used in the short term to support sabbatical exchanges of college of agriculture professors with preeminent nonland-grant academics and to reinstate stronger basic science programs in our agricultural schools. Long-term endowed chairs should reestablish "a cadre of experts who assure a continuous stream of bright, imaginative scientists graduating from our land-grant institutions," according to the Board.

State of Public Labs "Inexcusable"

Calling the lack of funds to bring state-of-the-art instrumentation to public laboratories "inexcusable," the UAB proposes an equipment and instrumentation program, modeled after the NSF program, be initiated within USDA and financed by a half percent of all USDA agricultural research and extension funds. In order to gain the maximum benefits from this program, the UAB says "centers of excellence" should be designated as major recipients of the equipment.

To reduce the present proliferation and duplication of federal and state facilities will, according to the report. require a change in "the almost insurmountable political opposition" facing USDA through the congressional patronage system.

The Extension Service. responsible for adapting technology to producers. must also gear up and use new technology transfer. The UAB recommends competitive funding be made available for improving computer capabilities related to such transfer operations.

Administrative Costs "Intolerable"

SAES funds must be used to fill gaps and SAES administrators must work on "integrated coordination and regional planning in order to facilitate improved use of diminishing financial resources." says the UAB.

The "exorbitant" administrative costs in the Competitive Grants Programs are as "intolerable" as the high ARS administrative costs cited in the 1982 [UAB] report, according to the Board. The UAB proposes that the Senate Appropriations Committee set maximum administrative costs for the USDA program similar to those established for NIH grants.

ARS Six-Year Plan "Short-Sighted"

The UAB report also responded to the six-year plan for the Agricultural Research Service recently proposed by ARS (see DIVERSITY, no. 4, p.4). That plan addressed many of the same concerns discussed in the Board's 1983 report to the Secretary. While applauding the ARS effort, the Board disagreed with many of the strategies proposed by ARS for emphasis or de-emphasis of major program areas. Specifically, the Board called the decreases in the area of plant productivity "short-sighted and unacceptable-especially at a time when new scientific breakthroughs are imminent."

For further information, contact: Barbara Fontana, Executive Secretary, Users Advisory Board, Room 351A-Admin Bldg., USDA, Washington, D.C. 20250.

Nobel Prize to Barbara McClintock Elates Plant Breeders

"They called me crazy. absolutely mad They thought I flipped my top," Barbara McClintock told reporters last year, referring to the mainstream reaction by most scientists to her discovery 40 years ago of "transposable genetic elements" or "jumping genes." That discovery by the solitary and independent 81-year old corn geneticist-that a moveable gene is responsible for the variety of coloration found in corn kernels--led to the 1983 Nobel Prize in Medicine, an honor that has elated plant breeders and geneticists throughout the world.

William L. Brown, an eminent maize breeder and colleague of McClintock's. recalled that many scientists characterized McClintock's revolutionary theory that genes move-contradicting the then-prevailing scientific tenet that genes were immutably fixed along the length of the chromosome-as "heretical." Brown, who currently chairs the Board on Agriculture of the National Academy of Sciences National Research Council. views McClintock's theory as "one of the most important in the field of genetics."

McClintock's biographer, Evelyn Fox Keller, confirms the fact that McClintock always had the respect of many classical geneticists such as Brown. In fact, her early work in corn genetics was recognized by her election to the National Academy of Sciences in 1944. By that time, she had taken a position with Carnegie laboratory at Cold Spring Harbor, Long Island, where she continues her work today. By 1951, McClintock's painstaking study of the mutations in corn plants led to the presentation in a paper *(Chromosome Organization and Genetic Expression)* of her radical theory at a Cold Spring Harbor symposium. The response, according to Keller in the recently published biography, *Feeling for the Organism: The Life and Work of Barbara McClintock,* was met with "a stony silence."

Despite increasing encouragement from other maize geneticists, it was only in the last decade-when advances in molecular and microbial biology led to the discovery of transposable elements in bacteria-that McClintock's work was acclaimed for its significance and actually credited as being the basis for much of today's research in genetic engineering. (The myriad tributes to McClintock since 1970 include the National Medal of Science, the Albert Lasker Award, and the designation by the MacArthur Foundation to be its first Prize Fellow Laureate.)

It should be remembered, a colleague of McClintock's observed, that her main ideas were formed before the structure of DNA was discovered. Even if microbiologists and biochemists had understood her ideas. he continued, "they would not have been able to rationalize her postulates." To many, that-and the fact that the maize McClintock was working with was a far more complex organism than the bacteria used in the later studies-makes her discovery and theory even more astounding.

In recognizing McClintock's achievements, the Nobel Committee credited her with "great ingenuity and intellectual stringency." The Committee stressed that she had been "far ahead of" the recent developments in molecular genetic and pointed out that she had published alone, with little response from her peers, much as Gregor Mendel did in the 19th century when he discovered the basic patterns of genetic inheritance through studies on garden peas.

Though McClintock called the Nobel award an "extraordinary honor," she characteristically shunned attention the day the award was announced (October 10th) and went, according to colleagues. on her daily walk to gather walnuts. When she returned for the obligatory press conference, she confided:

Photo courtesy of David Micklos Cold Spring Harbor Laboratory

It might seem unfair to reward a person for having so much pleasure, over the years, asking the maize plant to solve specific problems and then watching its responses.

Those familiar with McClintock's life and work were not surprised by this sentiment. They had seen her fight prejudice in many forms-from the time she determined to enter the very "unladylike" profession of plant breeding to her steadfast insistence that the changing colors she observed on the ears of Indian maize had far-reaching implications that could revolutionize the study of genetics-for what she sees as the privilege of working with crop plants.

McClintock maintained-as she has throughout her lonely odyssey in plant genetics-that she knew her work had been unacceptable to many. "That was alright when you know you're right, you don't care. You know that sooner or later it will come out in the wash." Her experience taught her, she said, that "You don't need the public recognition You just need the respect of your colleagues."

That respect was most eloquently articulated in a statement Charles F. Murphy, USDA/ARS National Program Leader for Grain Crops, made to DIVERSITY following the announcement of the Nobel award:

The genius of Barbara McClintock has long been recognized by plant geneticists and breeders. The acknowledgement of her contributions by the Nobel Committee is a magnificent although belated. personal tribute. Like the earlier recognition of Dr. Norman Borlaug [recipient of the 1970 Nobel Prize for his development of "miracle wheats"], *this award also brings some measure of glory to others engaged in the rather unglamorous-but uniquely successful and beneficial-science associated with plant improvements.*

DIVERSITY asked David H. Timothy, a noted plant breeder who has worked with McClintock at various times during the past 25 years, to comment on how the recognition of McClintock's work might relate to the need for an effective plant germplasm system. Timothy, along with his colleague at North Carolina State University, Major M. Goodman, has worked extensively in the area of maize genetics. They recently coauthored a paper on the need for germplasm preservation based on an analysis of maize genetic resources (see page 22).

Of Dr. McClintock's work, Timothy said:

Barbara McClintock's work in toto *contributes toward two superficially contradictory goals in manipulating genetic diversity in plants. One of these leads ultimately to a completely engineered genome. The other requires maintenance of extant germplasm resources. This false paradox is resolved by the realization that, for example, if the documented typical collections of maize races had not been maintained, then her interpretation of the significance of the chromosome constitutions of maize races would have been impossible.*

The excitement and publicity of her award, coupled with current interest in 'genetic engineering' may generate the notion that efforts in the maintenance of genetic diversity can be diminished. This must not *be allowed to occur, for we cannot, at will, yet design* a priori *and produce biotechnologically the kinds of plants needed for the world's diverse agricultural needs.*

DeKalb-Pfizer Develops Method For Measuring Genetic Diversity

Researchers at DeKalb-Pfizer Genetics, Inc., have devised a method of measuring genetic diversity among commercial corn hybrids that can influence the farmer's choice of seed corn, A. Forrest Troyer, the company's vice president for research and development, told reporters attending a communications symposium held recently in DeKalb, Illinois.

The new method uses the inverse relationship of inbreeding depression to genetic diversity and compares the performance of crosses and selfs of commercial hybrids for yield and other characteristics, said Troyer.

He explained that other methods such as assessing the number of widely used inbreds underestimates genetic diversity, while assessing the number of hybrids available overestimates genetic diversity. What is needed, according to Troyer, is a logical genetic-agronomic method that is quantitative and based on an important agronomic trait with a sound genetic theory.

Commercial Incentive to Broaden Genetic Base

Troyer called the method "relatively simple and straightforward," and said the results may be used to compare company hybrid averages, compare newer hybrids with older widely grown hybrids or to compare pairs of companion hybrids. To date, DeKalb-Pfizer Genetics research scientists have collected data on ten widely-grown commercial hybrids consisting of five hybrids from each of two companies.

This method provides an additional characteristic to aid farmers in choosing hybrids, said Troyer. He told reporters that "by offering a hybrid choice based in part on genetic diversity we can create a much-needed incentive for seed companies and plant breeders to broaden the genetic base."

For further information, contact A. Forrest Troyer, Vice President, Research and Development, DeKalb-Pfizer Genetics, 3100 Sycamore Road, DeKalb, IL 60115, (815) 756-3671.

Photo courtesy of DeKalb-Pfizer Genetics

NPGS Capability Critical
(Continued from page 3)

could be terminated or passed on to appropriate state or private agencies."

Other biotechnical agricultural research priorities the UAB report identifies as holding significant potential include: genome structure and gene expression, resistance mechanisms of plants and trees to pests and diseases, plant biological stress, rhizosphere research, animal disease resistance, and animal biological stress (see box).

The UAB will report to the President and to Congress on the Administration's proposed FY 85 budget for these and other agriculture programs in February, 1984. For further information write: Barbara Fontana, Executive Secretary, Users Advisory Board, Room 351A-Admin Bldg., USDA, Washington, D.C. 20250.

Genome Structure and Gene Expression

As little is known about the molecular structure and organization of the genome or factors regulating individual gene expression in plants and animals, the UAB says the first priority for biotechnical research in agriculture is to identify and understand rate limiting steps in metabolism and growth for major crop, animal, and tree products. A knowledge base in genome structure and gene expression must be developed to realize the full potential for transferring genes from one species to another, altering DNA sequences, and developing metabolic and growth regulatory products that promote or arrest the system, according to the report.

UAB recommends that ARS increase funding in this area by $1 million in FY 1985. The UAB also proposes transfer of 50.5 million from Forest Service research to initiate a "Center of Excellence" to study fundamental molecular biology.

The report says that since ARS expertise in this area is minimal, such expertise may be needed to be contracted from universities outside the traditional agricultural colleges and suggests 50.5 million of the FY 1984 ARS postdoctural program be devoted to supporting students interested in basic plant and animal sciences and to develop long-term ARS expertise.

The UAB also recommends that provisions in the 1983 Jobs Bill for ARS facilities renovation be used to provide facilities to house frontier equipment and instrumentation and preeminent scientific expertise.

Resistance Mechanisms of Plants to Pests and Disease

Despite all control methods used in the U.S., including chemical treatments and the use of resistant cultivars, an estimated 12 percent of potential crop production and 16 percent of potential timber production is lost annually due to pests and diseases.

The UAB report asserts that bio-control offers potential solutions in this area, and cities genetic engineering of pathogenic microbes, antibodies developed through DNA techniques, and plant improvement through tissue culture and cloning techniques as examples.

To expedite research in this area, the UAB recommends the current $9 million ARS research program on resistance mechanisms be increased by $0.75 million in FY 1985 to carry out the following projects:

- select and improve toxin-resistant plant cells,
- identify biochemically vulnerable insect pests of wheat, corn, and soybeans to plant genes for genetic engineering exploration, and
- investigate the biochemical basis for genetic resistance to cereal rusts to overcome the chronic problems of disease-resistance breakdown in newly-bred cultures.

The Board also proposes that the Forest Service use $.25 million to initiate research in identifying and isolating genes from forest species that can be used to develop insect-resistant tree germplasm by means of genetic engineering.

Plant Biological Stress

Environmental stresses-drought, heat, cold, salt, toxic ions, and air pollutants - constitute the primary limiting factors for increasing the world's food supply, states the report. Predicted population increases and food and fiber requirements dictate that crop losses be lessened and production be extended to lands which, by today's standards, are marginal: and in addition, researchers must find ways to allieviate environmental stress so that such productivity can be increased or stabilized.

To address these needs, the UAB recommends ARS add $0.5 million to the FY 1983 $7 million base program to support work in the following areas:

- manipulating crops or their environments in ways which avoid or reduce stress,
- exploiting the genetic potential for developing new crop cultivars that are resistant to environmental stress, and
- elucidating the basic principles of stress injury and resistance in plants and evaluating the scope and nature of stress damage to crops.

Extensive Planning Efforts Now Required For ARS Plant Explorations

Scientists submitting proposals for foreign and domestic plant explorations to be funded by the Agricultural Research Service (ARS) will be required to follow a revised - and substantially more detailed-format beginning in 1984 (see DIVERSITY, no. 4,-p. 8). Proposals for ARS funding of plant explorations can be submitted by any qualified scientist.

The new format was adopted by the Plant Germplasm Operations Committee last June and recently approved by ARS. Robert Perdue, ARS plant exploration officer, told DIVERSITY the new format was designed with two purposes in mind:

- to guide prospective explorers into the thorough background study required to obtain the information they need for sound planning and effective implementation of field programs, and
- to fully inform reviewers who must make judgements by providing a basis for judging the merits of one proposal against the merits of another. In this way priorities can be effectively established when insufficient funding is available to support all accepted proposals.

Preliminary Research Required

In addition to the standard information such as dates, site descriptions of host countries or states, and budget estimates, the new format requires planning to include such items as host country or site requirements to obtain permits for collecting and APHIS (Animal and Plant Health Inspection Service) requirements for U.S. import of germplasm; any political factors regarding the host country that could affect the exploration; assessments of germplasm currently available and the use to be made of the germplasm collected: reviews of previous explorations for the same species in the same field; and information on any known plans for future explorations.

Other required details include: the names of suggested participants and their qualifications; cost for vehicles and fuel; currency/exchange rates and official holidays! supply equipment and mapping requirements and availability; an explanation of how the germplasm collection will be shipped to the U.S. or other destination and arrangements for distribution after arrival; names of contacts and cooperators and their expected contributions; and a listing of all references consulted.

The proposal format also asks for a detailed "justification" of the exploration explaining the specific need for this plant material: a field plan that requires anticipation of such details as road conditions. border crossings. etc.: and an itinerary to include an outline map with latitude and longitude information of each foreign point to be visited and the location of available gasoline supplies, hotels and restaurants. The explorer is also asked to indicate how travelers will accommodate to the lack of such facilities if they are not available.

Upon completion of the exploration the scientist will be required to file a summary report that must include:

- a catalog of all collections compiled from NER Forms 309 issued by the USDA Germplasm Resources Laboratory;
- a narrative report highlighting significant observations likely to be of interest to germplasm users or explorers who might visit the same area in the future and a list of all contacts indicating how they contributed to the mission; and
- a page-size map identifying principle points on the itinerary and important collection sites.

Submission Procedures

Scientists planning to submit a proposal for 1984 Plant Explorations should contact the coordinator of the region in which the scientist resides (see box) to obtain the proposal format and guidelines.

After objectives of the exploration are endorsed by either the appropriate Crop Advisory Committee (CAC)-or other qualified crop specialists when there is no appropriate CAC-the scientist planning to submit a proposal should consult the Plant Exploration Officer or other Plant Exploration and Taxonomy Laboratory staff for guidance and assistance in preparing the proposal.

Proposals are formally submitted to the appropriate regional coordinator and are reviewed by the CACs or crop specialists and the appropriate Regional Technical Committees. Prioritizations and recommendations are then made by the PGOC to the ARS Administrator for final approval. Scientists desiring a tentative judgement from the PGOC as to the feasibility of funding a proposal are encouraged to submit an abbreviated preliminary proposal to the regional coordinator.

For further information contact: Robert E. Perdue, Jr., Plant Exploration Officer, Plant Exploration and Taxonomy Laboratory. Bldg. 265, BARC-East, Beltsville, MD 20705, (301) 344-2431.

ARS Regional Coordinators

Regional Coordinator, NC-7
Regional Plant Introduction Station
Iowa State University
Ames, IA 50011
Telephone: (515) 294-3255

Regional Coordinator, NE-9
Regional Plant Introduction Station Agricultural Experiment Station
P.O. Box 462
Geneva, NY 14456
Telephone: (315) 787-2244

Regional Coordinator, S-9
Regional Plant Introduction Station
Experiment, GA 30212
Telephone: (404) 228-7255

Regional Coordinator. W-6
Regional Plant Introduction Station
Room 59. Johnson Hall
Washington State University
Pullman, WA 99164
Telephone: (509) 335-1502

ARS Initiates Evaluation Work on National Small Grains Collection

The first series of systematic descriptor evaluations of wheat and oats accessions in the USDA National Small Grains Collection has been initiated at the Beltsville. MD., facility. The evaluation work is being supported by new funds made available this year. Approximately 2,000 lines or accessions planted for increase at the University of Arizona Branch Station at Mesa have been observed for thirteen agronomic descriptors, and head samples of these same accessions were collected and returned to Beltsville for future examination, David H. Smith. curator of the USDA Small Grains Collection. told DIVERSITY.

A set of approximately 5.000 wheats and 2.500 oats was selected on the basis of spring growth habit for evaluation at the University of Idaho Branch Station at Aberdeen for the same set of descriptors as those at the Mesa station. said Smith. Head samples collected on these two sets are currently being examined at the Idaho station. A similar group of accessions will be evaluated for the same agronomic descriptors in 1984. A cooperative agreement between USDA/ARS and the University of Idaho has been signed and a full time scientific aide has been hired to assist in handling the evaluation nurseries planted at Aberdeen.

Evaluation of the collection for disease and insect resistance was also initiated in 1983, and will be continued in 1984. To date. said Smith, some data have been recorded on Hessian fly resistance and reaction to Leaf Rust. Bunt (smut) of wheat. and on Crown Rust and Barley Yellow Dwarf Virus of oats.

For further information, contact: David H. Smith, Bldg. 046, Agricultural Research (enter-West), Beltsville, MD. 20705 (301) 344-3022.

1983 Plant Breeding Research Forum Calls For Major Public Investment In Germplasm System

A report to be released early next year by the 1983 Plant Breeding Research Forum will recommend a base public investment of $50 million annually for National Plant Germplasm System programs. The 1983 Forum meeting was the second of a three-part program sponsored by Pioneer Hi-Bred International, Inc. to increase public awareness regarding the current scientific and budgetary problems facing plant breeders in meeting future world food needs. The 1982 Forum analyzed and reported on the relationship between public and private plant breeding efforts (see DIVERSITY No. 4. p. 4).

Delegates to the 1983 Forum. held in August at Heber Springs, Arkansas, examined issues relating to the conservation and utilization of exotic germplasm to improve plant varieties and broaden the genetic base (see box). The Forum delegates, a select group of plant breeders, geneticists, economists. and administrators representing both the public and private sectors in the U.S. and abroad, established early on during the three-day meeting that a sound germplasm conservation, evaluation, and utilization program was a requisite for maintaining gains achieved in food and fiber efficiency and providing such capability in the future.

Draft recommendations for the 1983 Plant Breeding Research Forum report were based on discussions following formal presentations by the six-member Forum Resource Council. The presentations, which will be published in their entirety in the final 1983 Forum report, included:

- *National and International Germplasm Management Systems by* Quentin Jones. USDA/ARS, Beltsville, Maryland.
- *Conservation and Use of Exotic Germplasm to Improve Bermudagrass and Pearl Millet* by Glenn Burton, USDA Georgia Coastal Plain Experiment Station, Tifton, Georgia.
- *Conservation and Use of Exotic Tomato Germplasm* by Charles Rick, Department of Vegetable Crops, University of California. Davis. California.
- *Utilization of Exotic Germplasm in Potato Breeding* by S.J. Peloquin, professor of plant breeding, University of Wisconsin, Madison, Wisconsin.
- *Collection and Classification Needs for Major Crops* by J.R. Harlan, professor of plant genetics, University of Illinois, Urbana, Illinois.
- *An Evaluation and Critique of Current U.S. Germplasm Management Programs* by Major M. Goodman, Department of Statistics, North Carolina State University, Raleigh, North Carolina.

Forum Draft Recommendations

Details of the Forum discussion will not be released until thegroup's report is finalized early next year. (Forum organizers invited a DIVERSITY editor to participate in the Forum as a delegate rather than as a reporter in order to promote an atmosphere conducive to frank discussion.) The following draft recommendations reflect. however. the basic concern expressed by the delegates that the vital, complex. and diverse germplasm system on which our agriculture depends is critically impeded by a lack of long-term planning. coordination. and funding:

- The Forum report is expected to recommend that **preservation and evaluation of current germplasm collections should receive priority emphasis** in the national germplasm program. Although participants agreed that further collection is not as critical a priority as the preservation of material currently held. their recommendations take into account special situations in which endangered races or species must be collected before they are irretrievably lost.
- One particular recommendation geared toward improving the effectiveness of the National Plant Germplasm System report is expected to call for the **appointment of a national leader and coordinator for each crop species.** Such a leader could work with the crop advisory committee for that crop and provide guidance to the designated crop curator. suggest the Forum delegates.
- A major point made by Forum participants in the draft recommendations is that a base collection of **plant germplasm is essential to provide molecular biology with the raw materials for genetic engineering** applications expected to revolutionize agriculture in the next century. Both germplasm resources and new biotechnical tools are essential. and one cannot be supported at the expense of the other, according to the Forum's draft report.
- The draft Forum Report also discusses the need for **more adequate public funding to support basic long-term germplasm**

(continued on next page)

Plant Breeders Need for Exotic Germplasm

In remarks to the Plant Breeding Research Forum participants prior to their deliberations (see story this page), Forum Chairman William L. Brown explained that plant breeders are not interested in the use of exotic germplasm simply because it is exotic, but rather to identify unique and useful genes existing outside elite breeding populations now being used. In defining exoticgermplasm Brown referred to a definition used by A.R. Hallauer and J.B. Miranda in their 1981 study, *Quantitative Genetics and Maize Breeding,* "to include all germplasm that does not have immediate usefulness with selection for adaptation to a given area."

Interest in the use of exotic germplasm for crop improvement has intensified since the Southern corn leaf blight epidemic wiped out up to SO percent of the crop in some states in the early 1970's. That epidemicalarmed the agricultural sector and led to an increasing awareness of the possible role of exotic germplasm in reducing the type of genetic vulnerability that can bring on such disasters (see DIVERSITY, No. 1, page 2).

The reasons many breeders cite for their limited use of exotic germplasm, said Brown, include the amount of time required to obtain useable material from exotic populations; the critical dearth of evaluation data for most of the accessions currently held in germplasm banks; and the lack of adequate methodology for effectively identifying unique genes.

Using maize as an example. Brown reported that aside from basic passport data there is little information available on most of the 14,000 maize collections now held at the CIMMYT (the International Maize and Wheat Improvement Center) germplasm bank in Mexico. The lack of adequate regeneration of these and other accessions held in CIMMYT and other germplasm banks to maintain acceptable viability of the older germplasm samples is another concern. This situation, observed Brown, could cause greater germplasm erosion in major germplasm banks than is occuring on the countryside.

These impediments to the use of exotic germplasm become more critical as one continues to examine the situation for maize: Almost all U.S. field corn traces its ancestry to the two races (Northern Flints and Southern Dents) which make up the parentage of Cornbelt Dents-from which all commercial hybrids are derived, said Brown. As the total maize germplasm of the Western hemisphere consists of more than one hundred races, it is clear that only a fraction of the total -which holds unknown potential for American agriculture-has been utilized in the United States, observed Brown.

Though working with adapted sources of germplasm -used almost exclusively by maize breeders at the present time -is undoubtedly the most efficient approach in the short run. Brown predicts greater long-term progress if the bases of maize breeding pools are broadened by introgression from a larger sample of genetic sources.

Even in the absence of germplasm evaluation data, said Brown, there is evidence that understanding the evolutionary development of the land races, cultivars and wild relatives that comprise a species can tell a plant breeder which sources of germplasm have been most influential, how to look for such sources of germplasm and where they are most likely to be found. Though exotic germplasm has long been used as a source of disease and insect resistance, introduction of such strains into appropriate breeding populations, should, Brown told the Forum participants, also increase genetic variability and enhance the potential yielding capacity of the derived populations.

Exotic Germplasm May Solve Water Problems for Cotton Growers

Genes from a primitive drought-resistant cotton plant-found growing wild in Mexico by plant explorers in the 1930's- may enable scientists to breed new commercial cotton varieties that require less water.

USDA researchers say there are two "genetic advantages" responsible for the water efficiency observed in the wild cotton strain:

- the plant has a root system with extra tube-like vessels called vascular bundles that carry more water and nutrients up through the plant to leaf surfaces. and
- the plant's leaf pores have a better mechanism for regulating the intake of carbon and the release of water.

ARS (Agricultural Research Service) Administrator Terry B. Kinney, Jr. said that in addition to enabling Southern Great Plains cotton growers to get by with fewer irrigations. "breeding these genetic advantages into tomorrow's cotton varieties will also provide insurance against the day when the Ogallala aquifer becomes too depleted to meet current irrigation needs. "When that time comes, Kinney asserted. "we will be ready with improved varieties so that growers of that six-state region can make scarce water go farther."

Terry Quisenberry. Director of the ARS Southern Great Plains Cotton Research Laboratory. Lubbock, Texas. where the IO-year interdisciplinary cotton research effort has been underway, first noticed the superior drought resistance of the wild cotton (which researchers have named T25) during his earlier work with germplasm from the World Cotton Collection. Scientists from Texas A & M University's Agricultural Experiment Station and Texas Tech University cooperated in screening genetic traits to develop the T25 germplasm. The germplasm is now being released to public and private plant breeders for use in developing commercial varieties, according to Quisenberry. For more information, write: Southern Plains Cotton Research Laboratory, Texas A&M University. Rt. 3, Lubbock, TX 79401.

Forum

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research on which, the delegates stressed, successful applied plant breeding depends.

- The draft recommendations also identify **reduction in the use of chemical pesticides to manage pests** as an important benefit that would result from plant breeding research under an effective germplasm program. The Forum report also addresses the need for additional research to develop reliable information for formulating **Animal and Plant Health Inspection Service (APHIS) regulations that would more effectively correspond to NPGS requirements.**
- Another issue the draft report addresses is the concern on the part of some developing countries about the collection of germplasm in their countries by scientists from the U.S. and other developed countries. The draft report is expected to propose **establishing educational and cooperative international programs** to respond to the sensitive issue of perceived exploition in this area.

Senator Advises Forum on Strategies

Humorous and practical advice to Forum delegates on how to tackle the overwhelming problem of communicating the urgency of plant breeding needs to the public was provided in an address to the group by Arkansas Senator David Pryor.

Pryor reiterated the critical relationship of effective plant breeding to the country's agricultural and economic future and urged delegates to establish a strong and unrelenting voice in communicating their needs to the appropriate power bases in Washington. Inspired by Pryor and the determination of other delegates. one Forum delegate told DIVERSITY,"Our society *must* elevate plant breeding and germplasm research to a national priority position -one as important as our defense capabilities."

The Plant Breeding Research Forum plans to widely distribute the 1983 Forum report and schedule a series of briefings for the media and appropriate government and private sector groups in early 1984. For further information. contact: Gordon McCleary, Director of Corporate Information. Pioneer Hi-Bred International, Inc., 400 Locust, Suite 700, Des Moines. Iowa 50309, (515) 245-0500.

National Board Debates Crop Advisory Committee Options

The National Plant Genetic Resources Board (NPGRB) was unable to break the impasse over how to handle the future administration and direction of the Crop Advisory Committee (CAC) system (see DIVERSITY. no. 4, p. 7) at its fall meeting at the University of California, Davis (UCD).

The Board initiated discussion of a draft proposal by an NPGRB subcommittee that would place the CAC system under the auspices of the Board with the Board's executive secretary assisting in the formation and direction of the various committees. Several Board members argued against this scenario, and asked for input from the National Plant Germplasm Committee, and others suggested that the ARS (Agricultural Research Service) Plant Genetics and Germplasm Institute would be the more logical focal point for CAC administration.

Lack of time precluded any specific action and NPGRB Vice Chairman Robert Kalton said the Board would continue deliberations at the group's spring meeting. Several observers predicted that resolution of the issue will be a long and difficult process, and voiced concern over losing momentum with the 23 CACs now in existence and with crop specialists requesting the formation of others.

Bentley Takes Active Role

The October meeting was the first opportunity Orville Bentley, assistant secretary, Science and Education, USDA, had to chair an NPGRB meeting since his appointment last year (see DIVERSITY. no. 3. p. 3). Bentley took an active role throughout the meeting and stressed throughout the Board's discussion of various issues his view that the effectiveness of the NPGS was "vital to the U.S. and worldwide food and fiber system." Bentley told the Board that "a lot is at stake" because the National Plant Germplasm System is "important to our whole agricultural enterprise."

The assistant secretary also accompanied the Board on a tour of germplasm-related facilities and programs at UCD that included the National Clonal Plant Germplasm Repository, the tomato genetic stock and peach and strawberry collections, and UCD genetic engineering laboratories. The group also toured Plant Genetics. Inc. and Calgene, Inc.

Board to Assess Impact of Genetic Engineering

Specific actions taken by the Board included a recommendation to the Secretary of Agriculture that a funding mechanism offering long-term support for the clonal repository system be established and the decision to form an NPGRB subcommittee to identify priorities for genetic resources research and its relationship to genetic engineering. Calvin Qualset, UCD, who will chair the subcommittee. said it was crucial for the Board to inform the larger scientific community that the work of biotechnologists is dependent on basic plant genetic materials.

The Board hopes to approve and publish a revised version of the 1979 NPGRB publication, *Plant Genetic Rcsources: Conservation and Use* (known as "The Red Book") sometime next year.

The Board also reviewed the results of a survey on genetic and breeding programs of horticultural crops conducted by Board members Howard Brooks, USDA/ARS, and H. Grant Vest, Texas A&M University, and discussed the concerns of both private and public horticultural scientists resulting from recent ARS moves to withdraw support for varietal development of horticultural crops. (DIVERSITY will report on the NPGRB horticultural survey and other issues debated by horticultural scientists at the 1983 meeting of the American Society for Horticultural Science in the next issue.)

Forage Exploration to China Deemed "Significant"

Germplasm collections made during a 1983 forage exploration in China-the first USDA-sponsored plant exploration in that country since the 1930-s- should be "a significant asset for forage breeding and cytogenetic programs in the U.S.," according to a report filed by the U.S. delegation.

The two-month expedition, undertaken by Douglas Dewey (USDA/ ARS, Logan, Utah) and William Tai (University of Manitoba, Winnipeg, Manitoba, Canada), resulted in 205 collections that included: *Roegneria, Elymus, Elytrigia, Leymus, Medicago. Astragalus, Hordeum, Bromus, Vicia, Stipa, Trifolium, Psathyrostachys, Agropyron, Phelum, Dactylis. Festuca, Poa,* and *Hedysarum.*

Dewey explained the significance of the trip in a recent interview with DIVERSITY. "Many of the important forage crops (crested wheatgrass, intermediate wheatgrass, Russian wildrye, Altai wildrye, alfalfa, various clovers, etc.) that are used on rangeland in western North America originate in Central Asia. Most of the germplasm of these species," said Dewey, "have been introduced from the U.S.S.R., with very little coming from China. An infusion of new forage germplasm from China should, therefore, enhance forage improvement programs in the U.S.," he explained.

Although the economic value of the forage germplasm collected in China cannot be estimated at the present time, Dewey said the scientific value from the standpoint of cytogenetics and taxonomy "appears to be substantial." He pointed out that several new grass species were collected on this expedition that have not been introduced previously into the U.S. These represent important additions to the worldwide collection of range grasses maintained at Logan, according to Dewey.

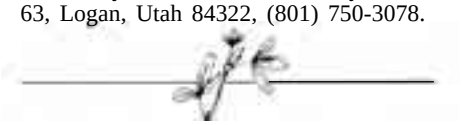
Chinese Gains Made

The Chinese stand to gain a great deal from this exploration as well, in Dewey's opinion, as Chinese scientists have accumulated only very small collections of forage plants and their breeding programs are just commencing. He estimates that the plant materials collected on this expedition should double the forage collections available to Chinese plant breeders.

All of the collected seed obtained during the forage exploration was turned over to the Crop Germplasm Resources Institute of the Chinese Academy of Agricultural Sciences at Beijing (see DIVERSITY, no. 3, p. 14). The Institute will be shipping these-as well as other materials Chinese scientists agreed to collect after Dewey and Tai departed-for distribution through the U.S. National Plant Germplasm System.

It is hoped that this arrangement will set a precedent for future U.S. plant collecting expeditions to China, said Dewey. He sees the agreement. negotiated by the USDA Office of International Cooperation and Development with the Chinese Ministry of Agriculture, which allowed U.S. scientists to collect forage germplasm in the wild as representing "a significant step forward in facilitating free exchange of germplasm between the two countries." In fact, he added, the contacts made during the trip with key individuals in the Chinese agricultural system "may prove to be our most valuable achievement."

For further information, contact Douglas Dewey, Crops Research Laboratory, Utah State University -UMC 63, Logan, Utah 84322, (801) 750-3078.



■ Other collecting trip reports on 1983 plant explorations filed with ARS Plant Exploration Office include: **cacao collection** in Costa Rica by P.K. Soderhold, Miami, FL: **cotton collection** in Australia by James Stewart, Knoxville, TN, and Paul Fryxell, College Station, TX; **sweet potato collection** in Peru by Wanda Collins, Raleigh, N.C.; **forage legume collection** in Morocco by Melvin Rumbaugh, Logan, UT, and Walter Graves, San Diego, CA: and **peanut collection** in Ecuador by Donald Banks, Stillwater, OK. DIVERSITY will provide details on these collections in a future issue. For further information contact: Robert Perdue, Plant Exploration and Taxonomy, Office Bldg. 265, Beltsville, MD 20705, (301) 344-2431.

Winter Nursery Accelerates Peanut Germplasm Enhancement and Cultivar Development

A USDA winter peanut breeding nursery program in Puerto Rico has contributed to the reduction of time required to develop improved cultivar and germplasm by as much as SO percent, Aubrey Mixon, ARS research agronomist with the Crops Research Unit at Tifton, Georgia, told DIVERSITY in an interview.

The winter nursery, which has been in operation since the early 1960's, is conducted each year through the cooperation of the Tropical Crops and Germplasm Research (TCGR) Unit of the USDA/ ARS Tropical Agriculture Research Station (TARS), Mayaquez, Puerto Rico. and the USDA-ARS Crops Research Unit, Tifton, Georgia.

Mixon has coordinated the efforts of the nine U.S. peanut breeders and scientists involved in the nursery program since 1973. The program is coordinated at Mayaquez by Sotomayor-Rio. TCGR Unit Location Leader, and Francisco Vazquez, argonomist. Wallace K. Bailey, USDA-ARS Investigation Leader for peanuts at Beltsville, Maryland, until his retirement in 1973, initiated the winter nursery in the early 1960's.

USDA Photo

Each fall, planting arrangements are made, and germplasm lines from cooperating U.S. scientists are assembled, documented, and shipped to Puerto Rico for field planting, said Mixon. In the spring (usually mid-April), Mixon and/or cooperating scientists make selections and record appropriate data at the field location near Isabella, Puerto Rico. After labelling, harvesting, drying and packaging, selections and increases are mailed directly to respective U.S. scientists for planting in the spring or summer.

Benefits to Peanut Breeders

The collaborative program allows breeders to get a second advanced generation of selections each year from crosses and advanced breeding lines, explained Mixon, which may reduce the developmental time of improved cultivar and germplasm lines by 50 percent. The winter nursery is also very useful in increasing seed quantities of foreign introductions and lines or cultivars for evaluation in Puerto Rico or the U.S., according to Mixon. Since peanut rust *Puccinia arachidis Speg.* occurs naturally each year in Puerto Rico, but is not usually endemic to the U.S., the nursery is an excellent location to evaluate germplasm for resistance to this fungus, he explained.

The winter nursery has been especially valuable to U.S. breeders, said Mixon, in advancing Fl crosses to the F2 generation, increasing advanced lines from crosses,

(continued on next page)

NEW CROPS

Crop Surpluses Spur Interest In "New Crops" Research and Development

Is there a realistic future for "new crops" development in the United States'! That question was of great interest to partici-pant\ at a symposium on exotic germplasm utilization for cultivar development sponsored by the Crop Science Society of America at the group's annual meeting in Washington. D.C.

The topic of new crops IS most appropriate in a discussion on the utilization of exotic germplasm for cultivar development, Quentin Jones (ARS. Beltsville. MD) told the symposium audience. because new crop development and new cultivar development have much in common in terms of objectives. the approaches and time frames required to reach them. and the need for sustained support over long developmental periods.

Although much is heard about the potential for new crops such as jojoba, crambe, meadow foam and guayule, Jones said it is likely that this potential "will never be developed unless we get serious about having a vigorous new crops research program [one] that is adequately funded on both the agronomic and utilization sides."

The current interest in new crops is part of a cyclical pattern that often occurs in crop surplus situations such as the current one. explained Jones, who has played a major role in new crops research for the U.S. Department of Agriculture (see following story). "Interest then seems to shrink with the supplies." he observed. The unfortunate aspect of the "new crops roller coaster." says Jones is that "the build-up takes longer than the let-down and we have relatively little to show for our efforts."

Despite these frustrations. Jones reports that the last new crop "boom" left U.S. researchers with a substantial information base on stem fibers as paper raw materials. on seed proteins, oils, waxes and gums, and on respective amino acids, fatty acids. esters. and the sugars comprising them. Also acquired, according to Jones. was considerable exposure to "the difficulties involved on the agronomic side in bringing a wild plant to successful crop status."

The biggest hurdle to overcome-even after researchers have a new crop that can be successfully grown and processed to meet known market needs- is how to get farmers and processors to take a first step together. Though each may feel comfortable with his area of responsibility, says Jones. neither is sure the other will do what is necessary to assure success in what must be a joint venture.

Broad-Use Categories for New Crops

Noting that only 0.1 percent (350) of the 350,000 world total of seed plants are now cultivated by man, Jones listed the following broad-use categories that. in his opinion, provide cogent reasons for a strong, well-supported new crops research program in the United States:

- More efficient water utilization
- Tolerate soils of high pH
- Tolerate soils of low pH
- Tolerate poorly drained soils
- Recover mine spoils
- Utilizing sludged areas high in heavy metals
- New sources of industrial products (oils, gums, waxes, hydrocarbons. fibers)
- Substitutes for crops in chronic surplus
- Replacing narcotic and other undesir-able crops
- Biomass for energy conservation
- Medicinal properties, including anti-tumor agents
- Enhancement of environments

Coordinated Cooperative Effort Required

All of these objectives involve research-able problems that can be addressed through available scientific approaches and technology, stressed Jones. Their attainment would. however. involve a coordinated program of research and development involving the federal. state and industrial sectors. Private industry would play a strong role in both identifying needs in the market place and funding commercialization of the new crop and its product once that point was reached. The need for a multi-disciplinary approach to new crop development cannot be overemphasized. asserted Jones. and should include biological and physical scientists. economists, engineers and communications specialists.

CSSA Spotlights Germplasm Research

Other presentations at the heavily-attended CSSA exotic germplasm symposium included: *Introgression of Wild Germplasm in Oats, Barley, Sorghum, and Pearl Millet,* by K.J. Frey; *Utilization of Exotic Germplasm in Corn.* by M.M. Goodman; *Utilization of Exotic Germplasm in Soybeans,* by R.L. Nelson, *Utilization of Exotic Germplasm in Forage Grasses,* by K.H. Asay; and *Utilization of Exotic Germplasm in Wheat,* by B.C. Curtis.

Heightened interest in germplasm research was apparent throughout the five-day CSSA meeting. In addition to the special session on exotic germplasm. CSSA sponsored an International Symposium on the Conservation of Crop Germplasm. DIVERSITY will report on several of the following papers which were presented at the international symposium in a future issue: *The International Germplasm Program of the IBPGR,* by J.T. Williams: *A National Plant Germplasm System,* by Quentin Jones; *The Role and Experience of An International Crop-Specific Genetic Resources Center,* by T.T. Chang: *Plant Exploration: Planning, Organization, and Implementation.* by C.E. Simpson: *International Germplasm Collection. Conservation and Exchange at ICRISAT.* by M.H. Mengesha; and *Germplasm Preservation.* by L.N. Bass.

For copies and/or further information, contact: Crop Science Society of America. 677 S. Segoe Road, Madison, WI 53711, (608) 271-1212.

Winter Nursery

(continued from p. 10)

special line selections. and foreign introductions for evaluation and selection in Puerto Rico or in the U.S. the following summer at respective U.S. adaptation sites.

From 1973 to 1983. 2,681 germplasm lines have been grown in Puerto Rico. These included 316 Fl crosses advanced to the F2 generation, 1,770 advanced lines from crosses and special line selections, and 560 foreign peanut accessions. The advanced lines were either evaluated or selected for favorable production characteristics and/or for rust resistance. Mixon identified six cultivars officially released in the U.S. and 30 released germplasm lines that have benefitted from evaluation and selection in the winter nursery.

Cultivars

- Early Bunch (FL)
- Sunbelt Runner (USDA-GA)
- Tifrun (USDA-GA)
- Pronto (USDA-OK)
- Tamnut 74 (Texas)
- Spanco (USDA- OK)

Germplasm Lines

- *Aspergillus flavus* group resistant lines (USDA-GA): AR-1 through AR4; GRA-1 and -2; PI 337409 and PI 337394F
- *Cylindrocladium* black rot resistant lines (USDA-GA); CBR-1 through CBR-6
- Rust resistant lines (USDA-GA): Tifrust-1 through Tifrust 14
- Leafspot resistant line (USDA-GA): PI 109839
- Early Maturing line (USDA-OK): Chico

The respective cultivars were released because of improved productivity or seed quality, and the germplasm lines were released for their germplasm enhancement potential for sources of *Aspergillus* species seed resistance, plant resistance to Cercospora leafspot, *Cylindrocladium crotalariae* causal organism of Cylindrocladium black rot. or Puccinia rust, and for early pod maturity. Many U.S. peanut breeders have emphasized, Mixon added, that "the selection and evaluation resulting from the winter nursery could not have been accomplished without the Puerto Rico program."

For further information, contact: Aubrey Mixon, ARS-Crops Research Unit, P.O. Box 748, Tifton, GA 31793, (912) 386-3561.

USDA Breeders Predict New Energy Crop For Farmers By 1990

USDA scientists report that smooth sumac-a woody perennial native to North America-may be one of the new "energy crops" that could give farmers a boost as profitable alternatives to corn and soybeans in the 1990's.

Smooth sumac *(Rhus glabra)* would grow wherever corn and soybeans grow and would draw a higher price in today's market because the whole plant can be processed to yield more types of products. Austin Campbell (ARS-Beltsville, MD) told the recent national meeting of the American Society of Agronomy. Based on preliminary economic analysis. "the oil and protein from an acre of soybeans is not worth as much as the polyphenols, oil and protein from an acre of *Rhus,"* said Campbell.

To be profitable, however. new handling, processing. and marketing systems would have to develop alongside the new crop, according to scientists at the ARS Northern Agricultural Energy Center in Peoria. Illinois. The center. which was established as a result of 1977 congressional legislation. has surveyed more than 500 plant species for energy-rich "botanochemicals." Smooth sumac is a semifinalist as a multi-use crop. according to the survey.

Although its products would not power the family automobile, the plant is rich in tannins-chemicals currently imported from Europe for leather manufacture- and other polyphenols that could serve as antioxidants or be converted into adhesives and resins for use in the manufacture of plastics. After these chemicals are extracted, Campbell said, the residue could serve as high-protein cattle feed.

Researchers say tests show that smooth sumac grows well from seed, and can be harvested once during the planting year and twice a year. in spring and fall. thereafter. If adopted on the farm. Campbell explained. the whole plant would be cut. allowed to dry and baled much like hay, then hauled off to an extraction plant nearby.

Campbell. who is cooperating with the energy center in Illinois to study smooth sumacs potential as a field crop, evaluated plants grown from seeds gathered at 17 locations in three states to determine if smooth sumac can be improved through breeding. After statistically analyzing the variation in growth characteristics - such as plant survival. vigor. dry matter yield. and number of secondary shoots-as well as the variation in polyphenol and oil content, Campbell found significant genetic diversity and has concluded that smooth sumac "has the potential for great improvement in botanochemicals through breeding. and for moderate improvement in yield through breeding and improvement."

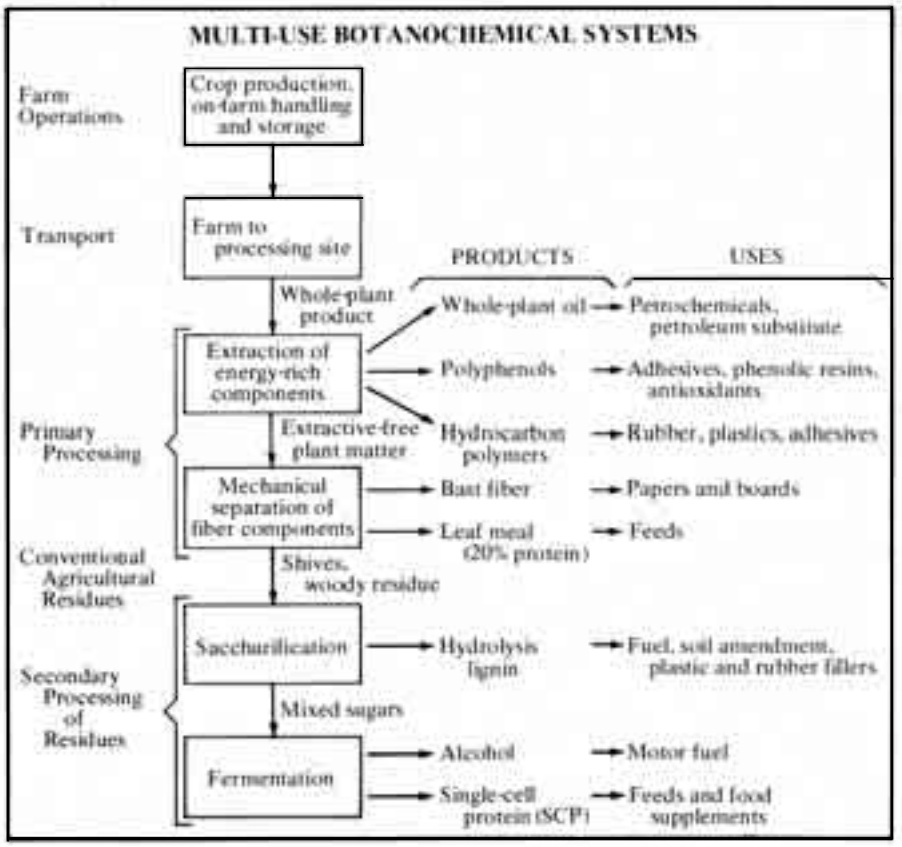
The USDA agronomist sees no problem in improving protein content through breeding. According to reports by energy center scientists. residues of smooth sumac already contain about seven percent crude protein, which is only two percent below the level deemed necessary to make smooth sumac competitive as a high-quality animal feed.

Yield. said Campbell, poses the only potential problem. but that depends on which economic analysis one relies on, he added. Campbell estimates 5 to 10 years of breeding should bring smooth sumac up to par as a cash crop.

For more information about "energy crops" and the potential uses of botanochemicals. contact: Marvin Bagby, Manager. Northern Agricultural Energy Cente, 1815 N. University, Peoria. IL 61604, (309) 685-4011, ext. 365.

USDA Photo

USDA Scientists examine a wild stand of smooth sumac, one of 34 plant species showing good possibilities for development as an "energy crop."



INTERNATIONAL PERSPECTIVE

U.S. Quarantine of Mexican Wheat: Dilemma For Researchers and Exporters

Wheat and triticale germplasm imported from Mexico for research purposes is now subject to stringent permit requirements recently announced by the Department of Plant Protection and Quarantine (PPQ). Animal and Plant Health Inspection Service (APHIS). USDA. The new requirements-which many fear could have serious consequences on worldwide wheat research and breeding-is the result of a ban imposed last April on all wheat from Mexico. That ban extends to seeds or grain. plants. straw (except decorative). chaff. and products of the milling process (other than flour of wheat) including all varieties species and hybrids of *Triticam.*

The decision to impose both the commercial wheat prohibition and the germplasm entry requirements was made. according to PPQ officials, in order to protect U.S. wheat from the possible introduction of an exotic disease organism. known as Karnal bunt (see box). The disease first appeared in North America in 1970 when it was discovered at Ciudad Obregon in Sonora, Mexico, Ciudad Obregon is the main location for wheat export from CIMMYT, the International Maize and Wheat Improvement Center. Karnal bunt was not observed again until 1981 when samples of wheat from the same location was intercepted in a mail shipment of wheat grain at Larado, Texas. and was found to be infected.

Karnal Bunt Causes PPQ To Take Emergency Measures

Anticipating the shipment of various wheat research plant materials in April 1982, PPQ officials imposed an emergency action in March of that year requiring that all wheat seed from Mexico be treated with PCNB (pentachloronitro-benzene) and so certified by Sandiad Vegetal (the plant protection service of Mexico). Officials say data available to them at that time indicated complete effectiveness could be expected. One PPQ report specifies that the decision to allow the continued importationsof Mexican wheat seed-provided the seeds had been treated-was based on results CIMMYT reported from laboratory experiments indicating PCNB prevented spore germination 100 percent.

In 1983, however, Karnal bunt reappeared once again at Ciudad, Obregon-this time in seed harvested from the research plots themselves-virtually assuring. says a PPQ scientist. that a high percent of the seed would be spore contaminated if not actually infected. Of further concern to PPQ officials were results of USDA tests indicating that PCNB appeared to be fungistatic (arresting spore development) rather than fungicidal (killing spores). Assuming the latter, PPQ scientists determined that even treated seed represented a risk of spreading the disease because the chemical probably would not be effective over the life span of the spore (3 to 5 years).

Adding to the growing concern over the potential damage Karnal bunt could pose to U.S. wheat crops was additional information on the impact the disease has had in India, where it was first reported in the 1900‘s. PPQ says Indian scientists report that the disease. whose damage is variable depending on varietal susceptibility and environmental factors, is becoming more prevalent and serious in that country.

Impact on Export Markets Feared "Devastating" - USSR, China Biggest Importers

Economic considerations also weighed heavily on officials assessing the situation. Both USDA and private sector sources told DIVERSITY that the most devastating aspect of the problem could be the effect on U.S. export markets if Karnal bunt were to become established in the United States.

The two major consumers of U.S. wheat exports, which exceeded 42 million metric tons in FY 1981, are the Soviet Union and the People’s Republic of China.

PPQ reports that China’s concern over foreign smuts in U.S. wheat shipments already exists due to the discovery several years ago by the Chinese of a smut *(Tilletia Cantraversa)* in U.S. shipments. The Soviet Union has specifically listed against importing shipments affected by Karnal bunt. and requires the U.S. to issue phytosanitary certificates as proof.

USDA observers predicted that other foreign wheat importers would be quick to prohibit or severely restrict the importation of U.S. wheat if it was found that the United States had become infected.

Safeguards Imposed on Germplasm For Research

These factors all contributed to the difficult decision by APHIS officials to prohibit importation of all wheat from Mexico and to allow entry only of experimental seed under permits requiring strict safeguard conditions.

The APHIS permitting requirements for the entry of wheat germplasm from Mexico. recently published in the *Federal Register* (“Wheat Regulations.” 7 CFR 319.59, October 14. 1983). call for very stringent safeguards to be followed for the 1983-84 growing season at the CIMMYT locations in Ciudad Obregon, Toluca, and Hermosillo, Mexico. If Karnal bunt is found in the material after testing, the Department will only allow greenhouse growing by scientists in the U.S. If Karnal bunt is not found, field growing will be allowed.

The safegard requirements pose a difficult situation for all those involved with wheat research. production, and export. Research on CIMMYT wheat. sent to the U.S. for evaluation under U.S. environmental conditioning, may be held up for a year or more, according to one U.S. scientist affected by the new requirements. Some scientists do not have access to greenhouse facilities and. to others. loss of the actual genes involved pose a particular problem. he explained. Several PhD theses have already been lost because of these restrictions. he told DIVERSITY.

(continued on next page)

Facts on Karnal hunt

Symptoms: The disease is spread by Infected seed and soil-borne spores of the pathogen. Infection is restricted to the grain only according to present knowledge of the fungus. Unlike other smuts of wheat, *N. indica* destroys only part of the grain, the tissue on the grooved side of the kernel, and is thus easily recognized. Dark brown to black spore masses are formed at the base and on the grooved ride of the grain, destroying the embryo tissue. Infected grams in the seed head are partially converted into black powdery masses containing smut balls of teuleutospores. Only a few grains in the affected heads of a plant may show the symptoms. In diseased lots, healthy looking seed may becontaminated by teliospores.

Hosts: On Gramineae: Triticum aestivum L. (-T. vulgare Vill.) and Triticale.

Distribution: Afghanistan, India, Iraq, Pakistan, Mexico.

Climatic factors: In India, Pakistan, and Afganistan the disease occurs in the foothills. Infection takes place when conditions are favorable during the flowering period. The optimum conditions for infection occur during periods of high rainfall, high humidity (about 70% RH). and temperature at 18-22 degrees Centigrade.

Pathways: Especially wheat seed, contaminated wheat products such as straw and heads, etc., bagging used for wheat grain from Infected areas, railroad cars from Mexico used for transporting wheat seed and wheat products, animal feed containing wheat, soil contaminated with spores, air, packing material, germplasm.

**Information provided by USDA/APHIS/PPQ*

Impact on CIMMYT

The impact of these restrictions on CIMMYT is almost synoymous with the impact on world wheat research as the non-profit international Center, part of the Consultative Group on International Agricultural Research (CGIAR) system, works with virtually every wheat producing country in the world.

Wheat experts estimate that over 300 high-yielding wheat. barley, and triticale varieties which carry CIMMYT-developed and/or distributed germplasm in their heritage have been released by national programs and that at least 35 million acres of developing country wheat area is currently planted with CIMMYT material.

Founded in 1966 as one of the first CGIAR-supported international agricultural research centers, CIMMYT has been a pioneer in the establishment of international germplasm sharing and testing networks. By encouraging individual breeders to share advanced generation unnamed lines as well as early-generation materials with each other, CIMMYT is credited by many as having opened "the modern era in plant breeding."

Shuttle Breeding Technique

Byrd C. Curtis, Director of the CIMMYT Wheat Improvement Program, says the program's central breeding objective is to develop widely adapted, management-response germplasm for world-wide distribution. To develop improved germplasm for these wide-ranging production conditions, CIMMYT employs what Curtis calls "shuttle breeding"- breeding materials are evaluated each year in Mexico at several research sites with markedly contrasting environments. By shuttling these materials between very different production areas in Mexico, and later to hundreds of locations worldwide through the international nursery program, CIMMYT has been able to develop germplasm with good adaptation between 35 degrees north and 35 degrees south latitude.

One of the two major sites used for the CIMMYT wheat "shuttle breeding" program is Ciudad Obregon. The other is located at Toluca.

Borlaug Lambasts APHIS

Nobel prize-winner Norman Borlaug, former director of CIMMYT's Wheat Improvement Program, characterized the U.S. action as "lacking common sense," and says it threatens the collaborative approach to wheat research responsible for the astounding successes in crop improvement begun 30 years ago. (It was Borlaug's breeding of "miracle wheats" that significantly contributed to the "Green Revolution" and earned him the Nobel Prize in 1970.)

The exchange of breeding material with CIMMYT cut in half the amount of time previously required to breed varieties, explained Borlaug in an interview. This invaluable distribution system is now "going out the window," Borlaug told DIVERSITY.

"Karnal bunt has never been a major disease anywhere in the world," according to Borlaug, and that, consequently, is the reason neither he nor his colleagues at CIMMYT have performed substantial research on it. "We've had more important problems," he asserted. "If the bureaucracy in the U.S. truly believes this is a serious disease with a potentially significant economic impact, why isn't it spending its research dollars to control it?" challenged Borlaug.

The Nobel Prize winner also criticized the U.S. plant quarantine system asarchaic in this modern era when fast travel has created a "shrinking world."'"These diseases are transmitted on the human body." observed Borlaug. "No quarantine can prevent this type of situation in today's world unless all tourism is stopped."

USDA Defends Decision

Several PPQ officials acknowledged unofficially that the U.S. action on Mexican wheat could have "a major adverse affect on the worldwide development and use of germplasm," and indicated that other USDA agencies and private seed companies are also concerned over the effect of the regulationson wheat improvement.

These officials say that while PPQ believes these concerns are legitimate. they don't believe it should be part of the Department's decision process or that PPQ should be in a position to weigh those impacts. "We have operated on the basis that PPQ's, responsibility is to weigh the pest risk and take the least drastic, but effective action without regard to other impacts," one PPQ scientist told DIVERSITY. He hastened to add that the Department has made every effort to include all parties in discussions prior to and after the ban.

PPQ records indicate that the Department has held a series of meetings that began last March with national scientific and industry experts on wheat diseases, as well as with Mexican seed producers and researchers. Those meetings have included representatives from the Wheat Growers Association. the Millers Association. the Wheat Exporter's Association. the American Seed Trade Association. the Crop Quality Council, CIMMYT, Sandiad Vegetal, the Plant Health Division of Agriculture Canada. the Agricultural Research Service. the Cooperative State Research Service. the Foreign Agricultural Service. the Office of International Cooperation and Development and the Federal Grain Inspection Service.

> "No quarantine can prevent this type of situation in today's world unless all tourism is stopped," said Borlaug.

Robert Kahn. senior staff officer for biological assessment, APHIS/PPQ, responded to some of the criticism being leveled at PPQ. He said the USDA has instituted a significant research program on Karnal bunt involving both lab and field studies and hopes data from this research will enable the Department to lift-or make less stringent- the permit requirements within one year. Kahn referred to a similar situation that occured in Mexico last year with citrus canker and said the U.S. is now allowing the material in. He added that USDA surveys of 46 plant breeders who received the wheat or triticale seed from CIMMYT in 1981 and/or 1982 and of commercial fields of wheat that were planted from the seed show no occurrence to date.

In a final interview with DIVERSITY. Kahn stressed that at each of the PPQ meetings all of the attending scientists were asked to analyze the benefits of the government imposing no restrictions on wheat germplasm from Mexico vs. the potential risks to our export market. "Not one of those scientists, including Dr. Borlaug, stated -as a matter of record - that such benefits exceeded those risks." asserted Kahn.

For details on the PPQ permit requirements and further information, contact: Frank Cooper. Permit Unit. APHIS-PPQ, USDA, Federal Building, Hyattsville MD 20782. (301) 436-8248

Left, wheat: center, rye: and right, triticale.

USDA Photo

Fruit and Nut Collection in Pakistan Of "Utmost Urgency"

A consultancy report recently filed with the International Board of Plant Genetic Resources (IBPGR) says it is of "utmost urgency" to make intensive collections in Pakistan of indigenous and naturalized temperate fruit and nut species as these genetic resources are "seriously threatened with extinction."

The IBPGR report notes that although there are no significant fruit breeding programs in Pakistan at the present time. within the northern Pakistan Himilayan region, there exists "an extensive reservoir of genetic variability in several fruit and nut crop species and related species of which it iscrucial to collect and preserve."

The report. submitted by Maxine Thompson. IBPGR/FAO consultant for fruit and nut genetic resources, warns that the irreplaceable plant genetic material "is being devastated by human and livestock pressures on the local flora" caused by (1) the accelerating destruction of all woody plants for fuel wood: (2) overgrazing: (3) clearing land for farming; and (4) the replacement of localselections with the rapid distribution and acceptance of a few select introduced cultivars. "Once lost. this variability upon which new improved cultivars are dependent will not be generated again, "said Thompson. Professor of Horticulture at Oregon State University.

Collection Priorities Identified

The report recommends that collection trips be initiated "as soon as possible" and identifies as first priority for collection the following: almond, walnut, apricot, apple, pear, pomegranate, quince, strawberry, Rubus sp., Ribes sp., plum, peach, mulberry, loquat, guana, fig, grape, *Diospyros lotus*, tree hazel, and Pinus gerardiana. Thompson suggests that Pakistani botanists, horticulturists and foreign plant breeders be asked to participate in these collection trips.

The report further recommends the establishment of a national clonal repository for temperate fruit and nut species at the Baluchistan Deciduous Fruit Development Center in Quelta. That site should also serve as the National Plant Introduction Center for potentially valuable commercial cultivars and clonal rootstocks of temperate species, according to the report.

Two additional Plant Introduction Centers are recommended at Sajawal for tropical fruits and nuts and at Faisalabad for subtropical fruits and nuts. Both of these facilities could be expanded into a broader clonal repository operation in the future. The greatest need for these two crop categories, according to Thompson, is "a vigorous program of introduction of the world's best cultivars and establishment of trial plots in appropriate regions."The report suggests overall leadership for all three centers be provided by the chief administrator of the Pakistan Institute for Plant Introduction and Genetic Resources (PARC).

Evaluation "Absolutely Essential"

The IBPGR consultant stresses that evaluation of all plant materials will be "absolutely essential because without at least minimal characterization the collection has no value" and suggests that Pakistani scientists use fruit and nut descriptors developed by the U.S. National Plant Germplasm System and the EEC Fruit and Nut Genetic Resources Group and others in order to effectively standardize the information. The report also recommends development of an information system that would be interchangeable with the U.S. Germplasm Resources Information Network (GRIN) and the EEC.

The IBPGR report is a result of extensive field trips Thompson made in Pakistan last spring on behalf of the IBPGR. In letters to the National Plant Germplasm Committee and the National Plant Genetic Resources Board, Quentin Jones. U.S. National Germplasm Coordinator. (ARS-Beltsville. MD), said the report "documents the positive influence the U.S. National Plant Germplasm System is having on other countries, especially developing countries."

"... the report documents the positive influence the U.S. National Plant Germplasm System is having on other countries."

For copies, contact: Quentin Jones. ARS-West, Bldg. 005. Room 140, Beltsville. MD 20705, (303) 344-3011, or Maxine Thompson, Department of Horticulture, Oregon State University. Corvallis. OR 97331. (503) 754-3695.

ARS and Oregon State Launch Ecogeographic Wheat Project In Middle East

An international collaborative program to collect and evaluate wheat germplasm from its centers of diversity in the Middle East is being implemented by the USDA Agricultural Research Service (ARS), Oregon State University, the International Board for Plant Genetic Resources (IBPGR), and the governmentsof Israel and Turkey.

The program will utilize an ecogeographic approach to germplasm collection (see DIVERSITY, no. 4, p. 8) of Mideastern wheat species that are now "in serious danger of being lost." according to a cooperative agreement recently signed by ARS and Oregon State University.

The project, involving Israeli and Turkish scientists and collaborators. calls for Oregon State University to:

- Obtain evaluative and other ecogeographic data as a prototype for the design of other germplasm expeditions;
- Provide support for specialists of various disciplines in preparing and training for ecogeographics field studies and for collecting in critical areas of eastern Turkey;
- Provide support for comparative studies of in-situ preservation vs. germplasm storage in controlled environment seed stores and/or in clonal repositories for maintenance of genetically heterogeneous Mideastern stands of Jointly selected wheat cultivars and varieties:
- Collaborate in field collecting. characterization, and documentation of Mideastern germplasm; and
- Share collected germplasm samples with the U.S. National Plant Germplasm System, the International Network of Genebanks. and the International Board for Plant Genetic Resources.

The terms of the agreement require ARS to:

- Cooperate in continuing the planning. collecting, and documentation of germplasm of agreed species;
- Provide ecogeographic advice, input. and field collaboration in thegathering of ecogeographic data in Turkey;
- Prepare a prototype graphic presentation of the data generated by the project in the development of an ecogeographic approach to germplasm collection and provide active and base storage for germplasm jointly collected;
- Encourage Israeli studies of in-situ germplasm maintenance technologies, protocols, and ecogeographic information management procedure at locations within the U.S. National Plant Germplasm System.

National Plant Germplasm System Coordinator, Quentin Jones. (ARS-Beltsville, MD) expects that with base funding of $139,000 beginning in 1983, the program will require four to five years in order to achieve these objectives.

Jones, who also represents the U.S. on the IBPGR. told DIVERSITY that the success of this project could result in its use as a prototype for other priority collections in the world's centers of diversity. "Our goal is to arrive at a point at which we can confidently say we've collected the necessary range of diversity-in this case of wheat-in a given target area." explained Jones.

For further information contact Quentin Jones, ARS-West. Bldg. 005, Room 140. Beltsville, MD 20705, or Wilson H. Foote. Associate Director, AES, Oregon State University, Corvallis, OR 97301.

VIEWPOINTS

Private Sector Plant Breeding Programs: A Major Thrust in U.S. Agriculture

by Robert R. Kalton and Phyllis Richardson

Private plant breeding programs are becoming increasingly important to the seed industry and to the farmer in the USA. Key factors contributing to this trend are the highly competitive nature of the seed business in many areas, demand for new unproved varieties and hybrids, passage of the Plant Variety Protection Act (PVPA) in 1970 (see DIVERSITY, no. 1, p. 23), and the phasing out of many practical breeding programs with the U.S. Department of Agriculture and a number of state agricultural experiment stations. Despite these changes, there is still a widespread lack of information concerning private breeding efforts and the possible impact of the PVPA on their crop improvement activities. The primary objective of this presentation is to try and overcome this shortcoming by providing concrete, current data on resources employed in private plant breeding.

In a survey of US. agricultural research by private industry, **Wilcke and Williamson (1977)** pointed out it was very difficult to acquire accurate or even representative information regarding true involvement of the private sector in research programs. Reasons given for lack of credibility of survey information were fear of antitrust action, loss of proprietary knowledge, lack of motivation, time to fill out forms. and failure to get survey forms to the right individuals. In their 1976 survey sent to representative seed firms, 38 companies who answered reported spending over $24 million on plant breeding.

- **Ruttan (1982)** discussed the changing role of public and private rectors in agricultural research and also noted R and D expenditure\ by the private sector were poorly documented. He Indicated the PVPA had encouraged an expansion of plant breeding efforts in the private sector, but said testimony by the reed industry regarding favorable effects of the 1970 act rested more on simple assertions than on presentation of evidence. It was his opinion that continuation of strong public involvement in plant variety improvement was clearly warranted since market incentives did not yet appear adequate to generate an efficient level of private research and development in this area.

- **Hanway** (1978) reached much the same conclusion from results of a questionnaire sent to heads of Agronomy, Crop, and Plant Science departments in 1977. He was interested in the effect of the PVPA on experiment station plant breeding and variety development programs. At that time, replies indicated experiment stations were doing the bulk of varietal development work on small grain crops, soybeans, grasses, rice, alfalfa, other forage legumes, and dry beans while commercial companies were developing more varieties and hybrids of corn, sorghum, sugar beets, cotton, and tobacco. Horticultural crops were not included in his study. Of the 47 institutions replying to his questionnaire out of 50 sent, 45 said they would continue to release varieties and 45 said availability of plant variety protection had not reduced plant breeding in their department. Hanway felt that it would take a strong cooperating team of scientists from many disciplines to develop improved crop varieties in the future and indicated that financing of such team research efforts would be beyond the scope of commercial companies. He concluded that experiment stations must expand their crop variety development programs.

- Quesenberry (1981) obtained some valuable data by surveying 48 agronomy, crop science, and horticultural departments in this country to determine the number of graduates trained in plant breeding from 1960-1979 and their placement trends. Of 1200 M.S. degrees granted during this period in plant breeding, 115 (10%) went into private industry. Results showed 45% of the plant breeding PhD's were from foreign countries but only 35% of all doctorates returned to their home countries. The author also intimated that a number of experienced plant breeding staff members had gone into industry through these years.

Members of the **National Council of Commercial Plant Breeders (NCCPB)** likewise have been concerned for a number of years about the lack of solid statistics to exemplify the true extent of private plant breeding efforts. In 1966, the senior author surveyed 46 leading seed companies with known breeding programs and results indicated close to 100 PhD and over 75 M.S. trained scientists were involved in private breeding efforts. Admittedly, this earlier NCCPB survey was not inclusive. Other attempts by NCCPB in the late 1960's to obtain information on dollar expenditures for private plant breeding yielded estimates that also were far from inclusive. Many companies failed to report because they considered research expenditures highly confidential then and still do today. It also seemed hard to sort out research from administration. sales. and other costs in company budgets.

New NCCPB Survey Indicates High Degree of Credibility

In light of these past surveys and their limitations, the President and Board of Directors of NCCPB decided a survey of scientists involved on a full time equivalent basis in private plant breeding would have considerably more significance and be easier to obtain than a strict financial summary. Accordingly, a form was developed early in 1982 which asked for the number of scientists with B.S., M.S., and PhD training working in each company on a full time basis in plant breeding. To obtain more detail, companies were asked to break down such efforts into a number of different major crop categories. The survey also included some broad groupings on annual research expenditures to try and get some idea on current outlays. NCCPB stressed very strongly in sending out the survey form, and in an accompanying letterexplaining theobjectives, that all replies would be held in strict confidence. It was pointed out that only summary information over all companies would be released. The survey was sent out to over 175 companies thought to be doing private breeding work and included the 61 members of NCCPB.

Response to the NCCPB survey was excellent, though it involved some follow up reminders. Completed replies were received from 160 companies, which appears to represent 90% or more of all companies conducting private breeding programs in the USA. So, the results presented here should have a high degree of credibility

Key reasons for conducting the NCCPB survey were to provide information that:

- could be shared with administrators of public breeding programs to assist them in long range planning
- would provide a basis for support of continued cooperative efforts with public researchers
- would accurately detail the current extent of private plant breeding efforts in term\ of scientific personnel on major crops in the USA
- could help determine the value of the PVPA
- would illustrate the number of companies doing breeding work on major crops in the USA
- would help enlighten public personnel relative to private plant breeding.

With these objectives in mind we can turn to our findings which are summarized in Tables 1, 2 and 3.

Scientist Resources Assessment

As can be seen in Table 1, there are over 435 PhD-trained plant breeders working in private industry in the USA along with 487 or more BS and 268 or more MS trained scientists. These figures must be considered as conservative inasmuch as a few companies (all relatively small) with known breeding programs declined to answer our survey. Inclusion of the BS and MS groups in the survey was considered to be very significant, as they are extremely important to private research programs. In public agencies, especially universities, BS and MS trained individuals provide the major source of technicians and graduate assistants on most crop breeding projects where they play a key role. Their importance in private breeding programs is no less significant.

The largest number of private plant breeder, by far is involved in hybrid corn with fruit and vegetable breeders second and soybeans a distant third. There also are substantial numbers of private breeders working with wheat, grain sorghum, alfalfa, cotton, and sunflowers. Considering these numbers, one certainly would have to conclude that private breeders are well equipped to carry on strong breeding programs in their own right!

Number of Companies in Private Breeding

Another way of looking at our survey results is to summarize the number of companies doing breeding work on each major crop. This analysis is shown in Table 2. As expected. more companies (66) are working with hybrid corn than any other category. Forty-six companies have breeding programs with fruit and vegetable crops. Many of these, Incidentally, are not necessarily involved in seed trade activities, but are mostly concerned with processing and distribution of such crops. For soybeans and wheat there are 26 and 21 companies, respectively, with breeding programs. Both of these are self-pollinated

Robert R. Kalton, Director of Agronomic Research, Land 0 'Lakes, Inc., is a past president and director of the National Council of Commercial Plant Breeders. Kalton, who heldpositions with USDA and Iowa State University before joining the private sector, currently serves as Vice-Chairman of the National Plant Genetic Resources Board. Phyllis Richardson is a research assistant with Land 0 'Lakes, Inc. Her work involves data analysis, seed and planting organization, and greenhouse and field research.

crops, although part of the wheat research is on hybrid potentials. The number of companies in sorghum breeding (21), most of which also breed corn, most likely is due to its essentially 100% hybrid acreage. Interestingly, 16 companies are working on hybrid sunflowers, despite the small US acreage and rather recent increased attention to this crop.

Company programs on cotton, forage and turf grasses, alfalfa, sugar beets, and flowers are not large in number but most are of long standing with many examples of proven varietal developments. Breeding work on wheat and other smallgrains in the private sector is quite recent in origin with only 1 or 2 companies involved in the early 1960's. Hybrid wheat potentials in the mid and late 60's incited several more companies to get into wheat breeding. Since then some have dropped out of hybrid research but more initiated breeding programs with wheat and other small grains in the early 1970's following passage of the PVPA.

Impact of PVPA on Private Breeding

One of the more dramatic impacts of the PVPA on private breeding research perhaps can be illustrated with soybeans. To our knowledge only one or two companies were doing limited soybean breeding work in the early 1960's. In 1965 the first commercialsoybean breeder with a PhD was hired to start a private program. From then to 1970, when the PVPA passed, a few other companies started private breeding programs on soybeans and hired PhD-trained breeders. Since then the number of companies in private soybean breeding jumped rapidly to 26 with a current scientific staff of 35.9 PhD, 15.9 MS and 41.8 BS personnel in total. To this evidence one can point out that 217 PVP certificates had been issued by May 25, 1982 for soybean varieties with a high percentage being privately developed. This is the highest number of certificates for any crop and over twice that issued for wheat (104). the crop with the second greatest number, according to Studebaker and Batcha (1982). In addition, a number of these new, privately-bred soybean varieties now coming on the market have an outstanding record of performance in yield trials. This brief summary offers a prime example of the effect of the PVPA on private breeding.

Research Expenditures

It was not our intention in establishing this survey to try and detail exact expenditures on private breeding work by any company. Rather. we set up several broad ranges of annual expenditures hoping that most companies would be willing to check off their ranking. Actually, almost everyone including all the major firms completed this part for which we are delighted.

A summary of the approximate annual research expenditures for private breeding work in 1982 for companies answering our survey is presented in Table 3. Significantly, these data show that private plant breeding research is not confined to the few large, multinational seed companies but is spread over a wide range of different size firms. If one uses the median value for each range (e.g. $250,000 for the $100,000 to $500,000 range) and $7.5M for the top rate, which seems reasonable, an estimate of total expenditures can be obtained by multiplying these values with the number of companies in each ranking. This exercise yielded a grand total of $114,950,000 which is probably a very realistic figure as well as a very substantial one. Here again such evidence indicates that private firms are willing to make very large investments in breeding endeavors.

TABLE 1. Number of BS, MS, and PhD scientists involved in private plant breeding on major U.S. crops in 1981.'

Major Crop Categories	*B.S.*	*M. S.*	*PhD*
Corn	201.9	100.25	155.1
Vegetables and fruits	95.70	62.3	96.35
Soybeans	41.8	15.9	35.9
Wheat	27.7	18.2	23.4
Forage legumes. mainly alfalfa	16.6	18.0	22.95
Grain sorghum	32.2	12.05	22.45
Cotton and other fiber crops	19.0	11.0	17.28
Sunflowers	12.8	13.0	15.0
Sugar beets	6.0	2.0	14.3
Forage and truf grasses	10.15	4.2	10.9
Barley, oats, rye, tritacales. millet	5.6	2.1	7.05
Rice	4.0	2.0	7.25
Flowers-ornaments	12.5	4.5	4.5
Safflower	1.2	1.0	1.7
Tobacco	0	2.0	1.0
Totals	487.15	268.50	435.13

1Data are based on full time scientist, year equivalents.

TABLE 2. Number of companies conducting breeding programs on major crops in the United States in 1982.

Major Crop Categories	Number of companies with breeding programs
Corn	66
Vegetables and fruits	46
Soybeans	26
Sorghum	21
Wheat	21
Sunflowers	16
Forage legumes	14
Cotton and other fiber crops	13
Forage and turf grasses	13
Oats. barley. rye. etc.	11
Flowers and ornamentals	9
Sugar beets	5
Rice	5
Safflower	3
Tobacco	3

TABLE 3. Approximate annual research expenditures on private plant breeding in the United States in 1982.

Expenditure group	*No. of companies*	*Projected Total*
0	9'	0
Under $100,000	44	$ 2,200,000
$100,000-500,000	62	$ 15,500,000
$500,000-1,000,000	23	$ 17,250,000
$1,000,000-5,000,000	17	$ 42,500,000
Over $5,000,000	5	$ 37,500,000
TOTAL	160	$114,950,000

1Several companies which were contacted conducted no research themselves, contributed funds to experiment station research on plant breeding, or sold varieties and hybrids developed by others on a royalty basis.

Summary of Survey Results

After looking over these results, one must conclude that **private plant breeding work is really very extensive in the USA.** With the difficult situation facing our agricultural economy and agribusinesses the past year or two (mergers, losses, new government programs, etc.) research staffing and expenditures are subject to change almost on a daily basis. However, because of the very high rate of completed returns, we feel the information obtained from our survey rates a high degree of credibility. It certainly should clear up the purported lack of solid statistics pertaining to private breeding research and the misinformation pertaining thereto.

Judging from the number of PhD's involved, **there are more private than public breeders on a number of crops,** namely, corn, soybeans, sorghum, sunflowers, alfalfa and several vegetable and fruit crops. It should be emphasized too that these private breeders were trained in much the same manner at the same universities as current public breeders. In the case of corn, with over 155 PhD's in private breeding, it is hard to rationalize Ruttan's (1982) conclusions that, "experience with hybrid maize, where proprietary inbred lines have provided even more secure protection than the provisions of plant variety legislation, casts doubt on the efficiency of private breeding programs." He

(continued on next page)

NEWS IN BRIEF

■ USDA has issued a **final rule increasing the certification fee for plant variety protection under the Plant Variety Protection Act** from $750 to $1500. Plant variety protection provides patent-like protection to developers of new and distinctive seed-reproduced plants ranging from farm crops to flowers (see DIVERSITY, no. I, p. 23). Thomas H. Porter, an official with USDA's Agricultural Marketing Service, said budget reductions and increased costs of operating the program made an increase necessary. The fee had not been changed since 1972. Among views expressed in the comments received on the increase, said Porter, was the belief that overhead of the plant variety protection off ice should not be a factor in establishing the fee, and concern that the higher fee would make it impossible for public agencies to file for certification. The increased fee has not, however, had an adverse effect on application for protection, according to Porter. In fact, he said, **applications have increased slightly** since the increase went into effect. USDA periodically publishes the *Plant Variety Protection Office Journal*. The journal includes listings of all plant variety protection applications filed and all plant variety protection certificates issued during a given period. For copies and further information, contact: Kenneth Evans, Acting Commissioner, Plant Variety Protection Office, Agricultural Marketing Service, USDA, Room 500, National Agricultural Library Bldg., Beltsville, MD **20705.**

■ **An inventory of soybean germplasm in the U.S. soybean germplasm collection in which the origin of each entry will he described** is now being prepared for publication, Richard Bernard, curator of the collection, told DIVERSITY. The distribution of the 9,343 entries received through 1980 by country of origin is as follows: **Korea** 32.6%, **USSR** 19.7%, **Japan** 18.4%, **China** 12.9%, other **Asia** 4.7%, **Europe,** 8.1%, and all other 3.5%. Bernard said the very large numbers from Korea are comprised of those obtained by a USDA expedition, as well as the recent collecting efforts by staff of the Crops Research Station at Suweon and by S.H. Kwon while at the Korean Atomic Energy Research Institute. The USSR is in second position due largely to the generous sharing of germplasm during the late 1970's by the Vavilov Institute in Leningrad. Japan has long been an important contributor, explained Bernard, and in 1974 sent a very large collection to the U.S. from their national seed storage laboratory. China-the center of origin of soybeans-is an important germplasm source, and many of the Chinese strains were obtained in the 1920's and 1930's or earlier. Although free germplasm exchange has not been allowed in China until recently (see story. p. 00), the U.S. has been receiving an appreciable number of Chinese varieties each year since about 1974. Together, said Bernard, these four countries have contributed directly about 84 percent of the total soybean germplasm in the U.S. collection.

■ **The International Board for Plant Genetic Resources** (IBPGR) of the Consultative Group on International Agricultural Research (CGIAR) recently **announced the availability of a number of internships at the pre- and post-doctoral level.** The internships will give opportunities for young scientists to gain good practical experience in some of the various aspects of crop genetic resources work, particularly in field work in areas of diversity and in scientific work with germplasm collections. They will be fixed-term for twelve months and may be extended depending on progress. Applicants should recently have completed a PhD or an MS, Ingenieur, Diploma or equivalent, in a scientific discipline related to crop genetic resources. Potential interns should write immediately and in confidence to Dr. J.T. Williams. Executive Secretary, IBPGR. AGP, Food and Agriculture Organization of the United Nations. Via delle Terme di Caracalla. 00100 Rome Italy. enclosing a full curriculum vitae and in a letter explain why they think they should be considered. There is no specific closing date for applications.

■ **Charles A. Brim, manager of soybean and corn research for Funk Seeds International, received the 1983 Genetics and Plant Breeding Award** at the annual meeting of the Crop Science Society in Washington, D.C. The award is presented each year by the **National Council of Commercial Plant Breeders** to an outstanding professional in either the public or private sector. During his career, which began with USDA/ARS at North Carolina State University in 1953. Brim has established an international reputation for both innovative research and productive applied research. Brim is noted for his work with the soybean cyst nematode, his method of "single seed descent" breeding, and early recognition of the potential for double cropping with wheat and soybean.

■ The **proceedings of the 18th Central Alfalfa Improvement Conference,** held June 8-10, 1983, at Kansas State University are now available. The program included sections on breeding, cytology, morphology, nitrogen fixation, diseases, insects, and management. For copies. write: D.L. Stuteville, Department of Plant Pathology, Throckmorton Hall, Kansas State University, Manhattan, KS66506

VIEWPOINTS

(continued from p. 17)

also indicated that private seed companies make only limited expenditures in such supporting sciences as genetics, plant pathology, and plant physiology. Unfortunately, he doesn't realize that many of the larger seed companies have well-trained plant pathologists, entomologists, computer scientists, seed scientists, biochemists, physiologists, and geneticists on their staffs.

No attempt was made to obtain information on these allied scientific fields in our survey. But, **the degree of sophistication in many private breeding programs is far greater today than many public researchers realize.** In the area of genetic engineering or biotechnology, a number of seed companies or their parent organizations have established substantial facilities and staff the last few years. Thus, they are ready to utilize any developments from this new field that can be used as a tool to expedite progress in plant breeding.

Estimates on annual research expenditures for private breeding based on our survey must be considered as very substantial as they go almost completely for developmental efforts. University funds, on the other hand, often are highly diluted by graduate training efforts, teaching, basic research, committee activites, etc. These are all extremely important, but based on the experiences of the senior author in both public and private research, **the private breeder is able to devote a much higher percentage of time as a breeder** *per se* than most public breeders. Wherein lies the most efficiency?

Taken as a whole, the information presented herein certainly provides some conclusive evidence on the extent of private plant breeding efforts in the USA. Such evidence deserves due consideration in overall planning stragegies for agricultural research in the future. **Private plant breeding is a classical example of free enterprise in this country** and all signs point to its continuation in a robust manner. There are many, many challenges to the plant breeding profession now as there will be in the time ahead. Thus, with funding limitations, both public and private, it seems logical for public researchers and administrators to gain more understanding of private breeding and to contemplate ways to coordinate efforts and cooperate over time for the greatest public good

REFERENCES

1. *Hanway, D.G. (1978). Agricultural experiment stations and the Variety Protection Act. Crops and Soils. Vol. 30. No. 5, 5-6, and No. 6, 5-7.*
2. *Quesenberry, K.H. (1981). Trends in plant breeding graduate education and placement. J. Agron. Educ. 10:94-98.*
3. *Ruttan, V. W. (1982). Changing role of public and private sectors in agricultural research. Science. 216. 23-29.*
4. *Studebaker, J.A. and J.A. Batcha. (1982). A chronicle of plant variety protection. Asgrow Seed Company. Kalamazoo, Mich.*
5. *Wilcke, H.L. and J.L. Williamson. (1977). A survey of U.S. Agricultural research by private industry. Agricultural Research Institute, Washington, D.C.*

- Lectures from the 1982 **Plant Science Lecture** Series at Iowa State University have been published in the May 1983 issue of the *Iowa State Journal of Research.* The Series was developed around the theme, **"Plant Breeding Solutions for Environmental Stress Problems in Crop Production."** Topics covered in the publication include:
  - Plant adaptation to mineral stress in problem soils,
  - The physiology of plant adaptation to mineral stress.
  - Modification of mineral nutrition in soybeans by plant breeding,
  - Reduction of iron by soybean roots; Coorelation with iron efficiency in calcareous soils,
  - Genetic variability and physiological mechanisms in drought resistance,
  - Breeding for drought resistance in range grasses,
  - Mechanisms for salinity tolerance in plants.

  Copies can be purchased for $7 by writing to Mary Jo Vivian, Agronomy Department, Iowa State University, Ames, IA 50011. Checks should be made payable to the *Iowa State Journal of Research.* Orders from outside the U.S. should be prepaid by international money order.

- **The International Soybean Germplasm Collection (INTSOY),** in conjuction with the curators of the **U.S. Soybean Germplasm Collection,** is conducting a **survey of worldwide soybean germplasm collections.** The program resulted from a meeting on soybean germplasm called by the International Board for Plant Genetic Resources (IBPGR) in 1982. Questionnaries have been sent out to 80 countries requesting information on the location, type, size and storage conditions of the collections. Survey results will be published by INTSOY and IBPGR in 1984, and copies will be available upon request from: Gail Juvik, INTSOY, University of Illinois, 113 Mumford Hall, Urbana. IL 61801. (The IBPGR provided the initial funding for the position Ms. Juvik recently filled as assistant curator to Richard Bernard. curator of the Northern Region Soybean Germplasm Collection at Urbana).

- The U.S. Department of Agriculture and Brazil's national agricultural research organization recently signed an agreement to cooperate closely in agricultural activities involving research, science, and technology. Under the agreement, **the United States and Brazil will exchange plant and animal germplasm** to improve the quality of crops and animals, and will share information and methodology used in genetic engineering, pest control, animal health, soil science, and energy related to agriculture. The agreement also provides for scientific exchanges, grants to agricultural scientists and students, and joint sponsorship of scientific conferences.

Willis H. Skrdla Retires

Willis H. Skrdla, Coordinator of the North Central Regional Plant Introduction Station since 1957, retired in September from the USDA-ARS and Iowa State University. He held the rank of Professor of Agronomy. Iowa State University. Supervisory Agronomist. and Research Leader, Plant Introduction Research Unit, USDA-ARS. His responsibilities included directing the work of seed increase, evaluation. preservation, and distribution of world collections of plant introductions and coordinating the work among the 12 State Agricultural Experiment Stations, other federal agencies. and private industry in the North Central Region as well as nationally and internationally.

Skrdla is a strong proponent of improving seed increase techniques for world germplasm collections through pollination control to maintain genetic integrity of individual lines as our legacy to future generations of germplasm curators. Toward this end he was influential in gaining support for controlling pollination of alfalfa. sugar beets. garden beets, various oil crops, for initiating research on techniques for pollinating wild sunflowers, and for improving techniques of certain vegetable crops.

In 1967, he led an expedition to Russia for collecting native forage grass, legume. fruit and ornamental plant materials from the wild to add greater genetic diversity to collections now held in the U.S. In 1980 he traveled to Bulgaria as a member of an FAO/United National Development Program Consultative Committee for establishing an Institute of Plant Introduction and Genetic Resources in Sodovo, Plovdin Region.

Skrdla's many contributions to the National Plant Germplasm System includes serving on numerous regional and national committees dedicated to the conservation and preservation of plant germplasm, most notably, a leadership role on the NC-7 Regional Technical Committee; establishing and chairing the alfalfa crop advisory committee (CAC) and serving on the maize, tomato, sugarbeet, and sunflower CACs; and most recently organizing the first national plant germplasm meeting (see DIVERSITY, no. 4, p. 6).

DIVERSITY asked Skrdla to comment on the changes in the National Plant Germplasm System that he has observed during his career:

> "There have definitely been some good changes in the management and operation of the NPGS. Recent funding increases have finally allowed the NPGS to break out of its shell of constraints and have given it the latitude to do what we should have been doing all along. If the NPGS is allowed to continue in this positive direction, the System will be of significant value to scientists everywhere and will be capable of producing a valuable product. We need to better understand and communicate various roles and responsibilities involved in this complex System. The establishment and continued work of the National Plant Germplasm Committee, and the Crop Advisory Committees are all good steps forward in that direction."

- **3. Neil Rutger, a rice geneticist with USDA's Agricultural Research Service, has been named "Scientist of the Year" for the Western Region of ARS.** Terry B. Kinney, Jr., ARS Administrator, said Rutger was chosen because of his "outstanding achievement in research on induced mutations for breeding improved characteristics in rice cultivars." Rutger, an adjunct professor at the University of California-Davis, **developed the first semidwarf rice cultivar in California,** Calrose 76, followed by another semidwarf early maturing cultivar, M-101. Using these varieties, industry breeders developed an additional five semidwarf varieties. These seven varieties are now planted on more than 50 percent of the rice acreage of California and their increased yields are worth more than $20 million a year, according to an ARS spokesman. Other improvements in rice cultivars developed by Rutger include cold tolerance and disease resistance. Rutger has become an international authority on rice genetics since joining ARS in 1970. He served as the external reviewer of the program review of the International Rice Research Institute (IRRI) (1980); is now the U.S. scientific liaison officer between the U.S. Agency for International Development, IRRI, and the U.S. scientific community; and last year headed the U.S. delegation to the 15th Session of the International Rice Commission in Sierra Leone.

• **The National Association of State Universities and Land Grant Colleges (NASULGC)** Committee on Biotechnology released its second annual Progress Report on **Emerging Biotechnologies in Agriculture: Issues and Policies** at the 97th annual meeting of NASULGC held in November in Washington, D.C. The Committee, chaired by F. Aloysius Wood. University of Florida, was established in 1982 to assess: land-grant institution structure and agricultural and biotechnological research program capability; education and manpower needs in biotechnological research and education; university/industry relationships; national biotechnological research program development, coordination and evaluation in the State Agricultural Experiment Station System: and the moral and ethical issues related to application of the new biological research techniques to agriculture. For further information and copies, contact: NASULGC, 1 DuPont Circle. NW, Suite 710, Washington, DC 20036, (202) 2937120.

• The following cultivar and germplasm releases were listed in the October 1983 issue of **HortScience** (Vol. 18. No. 5. pp. 766): **"Daytona" Grape,** by J.A. Mortensen and L.H. Stover. Agricultural Research Center, University of Florida, P.O. Box 388, Leesburg, FL 32749: **"Suwanee"** and **"Conquistador"** Grapes, by J.A. Mortensen, Agricultural Research Center, Florida (address as above); **"Elul"** Grape by P. Spiegel-Roy, R. Asaph, and I. Baron, Institute of Horticulture, Agricultural Research Organization, The Volcani Center, Bet Daga, Israel; **"Harvest Queen"** and **"Harrow Delight"** pears by H.A. Quamme and G.A. Spearman, Research Station, Agriculture Canada, harrow, Ont. Canada NOR 1GO; **"Novole"** Apple, by James N. Cummins and Herb S. Aldwinckle, New York State Agricultural Experiment Station, Cornell University. Geneva, NY 14456: **Cytoplasmic Male Sterile Brassica campestris** with resistance to clubroot, turnip mosaic, and downy mildew, by Hei Leung and P.H. Williams, Department of Plant Pathology, University of Wisconsin-Madison. 1630 Linden Drive. Madison, WI 53706; **"NemaSnap"** Snap Bean, by J.E. Wyatt. George Fassuliotis, J.C. Hoffman, and J.R. Deakin, U.S. Vegetable Laboratory, Agricultural Research Service, U.S. Department of Agriculture, Charleston, SC 29407. For furtherinformation, write: **HortScience,** American Society for Horticultural Science, 701 N. Saint Asaph St., Alexandria, VA 22314.

• The International Board for Plant Genetic Resources (IBPGR) has issued a **Report on the Practical Constraints Affecting the Collection and Exchange of Samples of Wild Species and Primitive Cultivars.** The detailed report identifies the lack of phenological information on the species to be collected and the heterogenity of seed maturing time as among the major constraints. For copies, write: IBPGR Executive Secretariat. Crop Genetic Resources Centre, Plant Production and Protection Division. Via delle Terme di Caracalla, 00100 Rome. Italy.

• USDA scientists have recently identified a **new peanut virus disease found to be widespread in peanut germplasm plots in North Carolina, Virginia, Georgia, and Texas.** The disease was apparently introduced to the U.S. via seed germplasm from the People's Republic of China. Preliminary studies indicate the virus is very infectious and spreads through seed and aphids. The Agricultural Research Service is closely monitoring the situation and is coordinating related research on the problem with the states.

• A group of distinguished scientists recently announced the formation of the **Committee for Responsible Genetics.** The Committee plans to work **"to insure that new biotechnologies be developed in the public interest"** by creating "a national forum" for compiling, evaluating and exchanging information about the social applications of genetic technologies. Among the major areas of concern the group plans to focus on is plant genetics and agriculture. For further information, contact: Terri Goldberg, P.O. Box 759. Cambridge, MA02238, (617) 491-5655.

• The **Germplasm Resources Information Network (GRIN),** the central database repository for germplasm information now administered through the Agricultural Research Service (ARS), should be **available to users early in 1984,** according to GRIN's acting project leader, Jim Mowder, USDA, Communications and Data Services Division. The new nine-member GRIN Database Management Unit (DBMU). working under the Plant Genetics and Germplasm Institute at Beltsville, Maryland, is currently completing the software modules that will insure database integrity.

DIVERSITY will provide detailed information on GRIN capability and user access in a future issue (see DIVERSITY, no. 4. p. 6). For further information, contact Jim Mowder, Bldg. 001. Rm. 130. BARC-West, Beltsville. MD 20705. (301) 344-3318.

• The Agricultural Research Service has invited selected crop specialists to participate in a **Workshop on New Methods of Modifying Germplasm of Plants.** The Workshop is expected to focus on identifying the most important problems that constrain development of improved germplasm of major crop and forage plants; determining the research needed to solve the problems: and developing a program plan to guide operational planning. Recommendations will be framed within the context of the recently proposed ARS Program and Six-Year Implementation Plan (see DIVERSITY. no. 4. v. 4). A final workshop report will be submited to ARS Administrator Terry B. Kinney in February, 1984. For further information contact: Philip Miller. National Program Staff. Rm. 308, Bldg. 005. Beltsville. MD 20705. (301) 344-2725.

• **The First Clover and Special Purpose Legumes CAC,** held in conjunction with the annual Crop Science Society of America meeting. appointed four plant exploration subcommittees (for arid-cool. humid-cool. arid-warm. and humid-warm grasses) to identify needs and provide technical guidance. The Subcommittees will also make specific recommendations and amendments for forage grasses to the preliminary Standard Description List that will be used by the Germplasm Resources Information Network.

• **The Clover and Special Purpose Legumes CAC,** which also met in conjunction with the the annual Crop Science Society of America meeting. passed a resolution, based on a report by CM. Rincker, ARS, Prosser, Washington. recommending that all Trifolium and special purpose legume species be stored at temperatures between -10 degrees C and -20 degrees C at all storage locations. The CAC also appointed a subcommittee to formulate germplasm evaluation strategies.

• At the last **Peanut Crop Advisory Committee** scientists identified West Africa, Mexico, and the People's Republic of China as the first priority areas requiring plant exploration and collections. Other priority regions the CAC identified included Burma in South Asia and the Andean Zone of South America. It was also reported that a new catalog of peanut germplasm should be available in December 1983. For further information, contact: J.C. Wynne, North Carolina State University, P.O. Box 5155, Raleigh. NC 27650 (919) 737-3281.

DEADLINE - LATE BREAKER

As DIVERSITY goes to press, a U.S. delegation headed by Secretary of Agriculture John R. Block is en route to Rome. Italy, to represent the U.S. at the **22nd session of the Food and Agriculture Organization (FAO)** in discussions on proposals currently under consideration for **the establishment of an international plant genetic resources bank and a related draft international convention for plant genetic resources.** The high-level U.S. delegation includes FAO Ambassador Millicent Fenwick, ARS Administrator Terry B. Kinney, and representatives from the State Department and USDA office of International Cooperation and Development.

Debate over the controversial proposal has escalated into **a split between developing countries and developed countries on whether the international germplasm activities now coordinated by the International Board for Plant Genetic Resources (IBPGR) should be put under FAO control.** Latin American countries led by Mexico. Columbia, El Salvador, Cuba and Peru are charging that the present system is inadequate; lacks the legal status to guarantee the free exchange of plant materials; and does not serve the interest of developing countries whose plant genetic resources are being exploited by developed countries. A delegation of developed countries including the U.S. and the European countries argue that the present FAO/IBPGR legal umbrella adequately insures the free availability of germplasm and that the proposed changes would be duplicative, excessively costly and would undermine the continuing progress achieved under the existing international FAO/CGIAR (Consultative Group on International Agricultural Research) system. The rights of private plant breeders is another critical issue of debate that is being supported by the developed countries.

At the Rome meeting the FAO Council will consider the report of a Working Group appointed by the FAO Director General to address issues raised by the various factions of the FAO Committee on Agriculture (COAG) which has been considering the proposal. In addition to the U.S. Working Group includes Mexico, El Salvador, Cameroon, Kenya, Australia, India, Malaysia, the United Kingdom, Sweden, Libya, and Cyprus. DIVERSITY will provide details on the FAO Conference and analyze the issues involved in the international controversy over plant genetic resources in the next issue.

MEETINGS

December 19-20- **Genetic Manipulation of Plants and its Application to Agriculture.** Birkbeck/University College. London. Contact: P.J. Lea, Dept. of Biochemistry. Rothamsted Experimental Station, Harpenden. AL5 2JQ, U.K.

January 8-13- **11th Aharon Katzir-Katchalsky Conference: Plant Molecular Biology,** Jerusalem, Israel. Contact: R. Goldstein. The Aharon Katzir-Katchalsky Center, The Weizmann Institute of Science. 76100 Rehobot, Israel.

January 9-10- **American Society for Horticultural Science, Northeast Region,** Annual Meeting, Geneva, NY. Contact: R.D. Way, New York State Agricultural Experiment Station, Geneva. NY 14456.

January 10-l4- **23rd annual Garden Seed Industry Conference** and **American Seed Trade Association Mid-Winter Meeting,** Monteleone Hotel, New Orleans, LA. Contact: ASTA, 1030 15th Street, NW. Suite 964, Washington. DC 20005. (202) 223-4080.

February 15-16- **Interregional Corn Conference.** St. Louis, MO. The conference is sponsored by public plant breeders from the four regions. Contact: L.F. Bauman, Life Science Bldg., Purdue University, West Lafayette. IN 47907, (317) 494-6380.

March 6-8- **20th Annual Illinois Corn Breeders' School.** University of Illinois, Champaign. Topics will include: Varietal origins of inbreds, organization of breeding programs. nitrogen metabolism and breeding. evaluation and use of exotics, monitoring and breeding for disease resistance, and selection theory and practice. Contact: D.E. Alexander. Department of Agronomy, University of Illinois. Turner Hall. 1102 S. Goodwin Ave., Urbana, IL 61801, (217) 333-4254.

March 19-21- **16th Stadler Genetics Symposium on Gene Manipulation in Plant Improvement,** University of Missouri, Columbia. The Symposium will focus on gene manipulation in plant improvement through 25 presentations by internationally recognized plant scientists. Contact: Hugh Keith, 344 Hearnes Bldg.. University of Missouri, Columbia, MO 65211, (314) 882-2429.

April 5- **Clover and Special Purpose Legumes Crop Advisory Committee Meeting,** Tifton, GA. The meeting will be held in conjunction with the Trifolium Conference. Contact: R.R. Smith, ARS. Department of Agronomy, University of Wisconsin. Madison, WI 53706. (608) 262-1090.

April 23-27- **Inter-Center Seminar on IARC's and Biotechnology.** International Rice Research Institute. Los Banos, Philippines. Seminar will include discussions on International Agricultural Research Centers and the "new biology," including techniques in biotechnology and genetic engineering. Cosponsored by Rockefeller Foundation and Centers of the Consultative Group on International Agricultural Research system. Contact: M.S. Swaminathan, Director General. International Rice Research Institute, P.O. Box 933. Manila. Philippine\.

June 18- **Forage Grass Crop Advisory Committee Meeting,** College Station, TX. 1 p.m., Soil and Crop Sciences Bldg., Texas A & M University. Contact: K. Asay, ARS, Crops Research Laboratory. Utah State University-UMC 63, Logan. Utah 84322, (801) 750-3069.

August 5-9- **Annual Meeting of the Botanical Society of America,** Fort Collins. CO. The meeting will include symposia on germplasm resources conservation and utilization and developmental plant genetics. Contact: David Dilcher, Dept. of Biology, Indiana University. Bloomington. IN 47405.

August 12-17- **World Soybean Research Conference** III, Iowa State University. Ames, IA. No other details are available at this time.

PUBLICATIONS

PLANT BREEDING REVIEWS, Volume I, Jules Janick, editor, Westport: AVI Publishing Co. Inc., 1983, 397 pp., *$33,* U.S.: $36 elsewhere.

The new review journal addresses the theory of breeding systems and methodologies, testing and evaluation, as well as matters pertaining to the profession of plant breeding such as plant breeders rights. Although major agronomic crops will be emphasized, including those used for fiber, ornamental and medicinal purposes, the editor says species of minor economic importance will also be considered.

Each volume will also recognize the career and achievements of a preeminent plant breeder. Volume I is dedicated to Henry A. Jones (1889-1981), "Plant Breeder Extraordinaire." Other topics covered in the first volume include: The *Genetics of Petunia,* by Andre Cornu and Daniel Maizonnier; Breeding *Common Bean for Improved Quantity and Quality of Seed Protein,* by F.A. Bliss and John W.S. Brown; *Genetics of Storage Protein in Maize,* by C.Y. Tsai; *The Use of Endosperm Genes for Sweet Corn Improvement,* by C.D. Boyer and J.C. Shannon; *Breeding Pearl Millet,* by Glenn W. Burton; *Breeding Soybeans Resistant to Diseases,* by J.R. Wilcox; *The Genetic Improvement of Black Walnut for Timber Production,* by Walter F. Beineke; *The Genes of Lettuce and Closely Related Species,* by R.W. Robinson, J.D. McCreight and E.J. Ryder: and *Breeding Apple Rootstock,* by James N. Cummins and Herbert S. Aldwinkle.

PLANT BREEDING REVIEWS is cosponsored by the American Society for Horticultural Science, The Crop Science Society of America, The Society of American Foresters and the National Council of Commercial Plant Breeders.

AVI, which specializes in areas related to agriculture and plant sciences, also publishes the **HORTICULTURE REVIEWS** series. Volume 5 of that series will be available soon. To order these volumes or to obtain further information on other AVI publications, write: AVI Publishing Co., 250 Post Road East, P.O. Box 831, Westport, Connecticut 06881, (203) 226-0738.

• **A recently published article by Garrison Wilkes,** Biology Department, University of Massachusetts-Boston, **discusses the "ominous conflict between agricultural modernization to optimize production, and the preservation of indigenous agriculture** along with the genetic diversity found in those areas associated with agricultural origins and development." The article, **"Current Status of Crop Plant Germplasm,"** examines such issues as the existing threats to crop plant germplasm and the impact of genetic engineering on germplasm research. Also included are detailed descriptions of the U.S. National Plant Germplasm System, international plant genetic resources conservation programs and many helpful tables and charts. "It is difficult to visualize," concludes Wilkes, "a challenge more profound in its implications yet less appreciated by the general public than plant genetic resources."

The article was published by CRC Press, Inc., in *Critical Reviews in Plant Science,* Vol. 1, No. 2, 1983, pp. 133-181. Copies are available from: Subscription Department, CRC Press Inc., 2000 Corporate Blvd. N.W., Boca Raton, FL 33431, (305) 9940555, or Garrison Wilkes, Biology Department, University of Massachusetts/Boston, Boston, MA 02125.

Agricell Report is a new monthly publication covering issues relating to plant tissue culture. Annual subscription rate is $180. For information, write: Agritech Consultants, Inc., P.O. Box 255, Shrub Oak, NY 10588.

Annual Wheat Newsletter, Vol. 29, Quick, J.S., Nell, J.S., eds., Colorado State University and Canada Department of Agriculture. Ft. Collins University Communications, 1983, 180 pp. Manuscripts for Volume 30 are due by February 1, 1984. For information and copies, write: J.S. Guide, Agronomy Dept., Colorado State University, Ft. Collins, CO 80523.

Barley Genetics Newsletter, Vol. 13, Haus, T.E., Ramage, R.T., Tsuchiya, T., eds. Colorado State University, Ft. Collins, 1983, 192 pp. Manuscripts for Vol. 14 due by February 20, 1984. For information and copies, write: T.E. Haus or T. Tscuchiya, Agronomy Dept., Colorado State University, Ft. Collins, CO 80523.

A FEELING FOR THE ORGANISM: The Life and Work of Barbara McClintock, by Evelyn Fox Keller, W.H. Freeman: New York, 1983,235 pp., $14.95. (See story, page 5.)

Genetic Engineering of Plants: An Agricultural Perspective. Basic Life Sciences Series, Vol. 26, Tsune Kosuge, Carole Meredith, Alexander Hollaender, eds. Plenum Press: New York, 1983,499 pp. The volume represents the proceedings of a symposium held in August 1982 at the University of California, Davis. The thirty-two articles by authorities in the field describe and assess recent advances in genetic engineering and discusses how these new techniques can be combined with existing plant breeding methods in an integrated approach to crop improvement. For further information, contact: Alexander Hollaender, Associated Universities Inc., 1717 Massachusetts Ave., NW, Suite 603, Washington, DC 20036-2077. (202) 462-4475.

Genetic Engineering of Plants-Quick Book, Witt, Steven C., California Agricultural Lands Project: San Francisco. 1982, 53 pp. The publication is the first in a series of Quick Books produced by the California Agricultural Lands Project, a non-profit organization to increase public awareness of farmland use and related issues. For further information, contact: California Agricultural Lands Project, 227 Clayton St., San Francisco, CA 94117, (415) 751-3144.

Maize Genetics Cooperation Newsletter, No. 57. Coe, E.H., ed., USDA and Dept. of Agronomy, University of Missouri, 1983, 236 pp. For copies and manuscript submission for Number 58, write E.H. Coe, Professor of Agronomy, Curtis Hall, University of Missouri, Columbia, MO 65211.

The Plant Seed: Development, Preservation, and Germination, Rubenstein, I., Phillips,R.L., Green, CC., Gengenback, B.C., eds., Academic Press, Inc.: New York, 288 pp., $31. The book includes a chapter, "Germplasm Preservation: The Basis of Future Feast or Famine-Genetic Resources of Maize-An Example," by David Timothy and Major M. Goodman, pp. 172-199.

Tropical Root and Tuber Crops Newsletter, No. 14. de la Péna, Ramon S., ed., College of Tropical Agriculture and Human Resources, University of Hawaii, 1983, 72 pp. For copies and information, write: Ramon S. de la Péna, University of Hawaii, College of Tropical Agriculture and Human Resources, Kapaa, Hawaii 96746.

USDA photo

Message to Our Readers:

As you know, DIVERSITY seeks to provide the plant genetic resources community with a more flexible and frequent medium for disseminating research and policy information than conventional research publications which usually take one to three years to appear in print. Our intention is to compliment rather than substitute for such formal publications as well as to provide a forum for readers to debate issues of current interest.

If DIVERSITY is to serve you in this way, it must be "nourished" with information that is uniquely familiar to you through your work. We ask that you keep us informed on policy issues and research developments which your colleagues would find of interest as well as notifying us about important meetings and conferences that are coming up. Such information need not be presented in the format required by formal journals, but rather as summaries highlighting significant findings or developments. We also invite you to personally speak out on issues by submitting articles for publication in the VIEWPOINTS section of DIVERSITY. We and the rest of our 600 readers from 30 countries around the world value and look forward to your participation.

Sincerely,

Deborah L. Strauss

Managing Editor

A Note to Our Friends in Private Industry:

DIVERSITY is wrestling with a funding situation that many of you and your organizations have faced at one time or another when beginning new projects.

As you know, our goal is to become self-supporting through subscriptions. However- because we are committed to a low subscription rate in order to make DIVERSITY reasonably affordable to *all* sectors of the plant genetic resources community-it will take time to accomplish that goal.

In the interim we are turning to you for help with our short-term funding needs. During the next several months a DIVERSITY representative will be contacting you about joining the DIVERSITY Sustaining Membership Program. Sustaining memberships range from $250-2500.

Please consider helping us continue the vital news service DIVERSITY is providing the world-wide plant genetic resources community. When you become a sustaining member, your name will be added to the roster of your colleagues listed on the back cover of this issue and will appear in each subsequent issue of DIVERSITY.

If you would like additional information, please contact: Martin McCormick, 419 Canyon St., Suite 320, Ft. Collins, CO 80521, (303) 224-9400.

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