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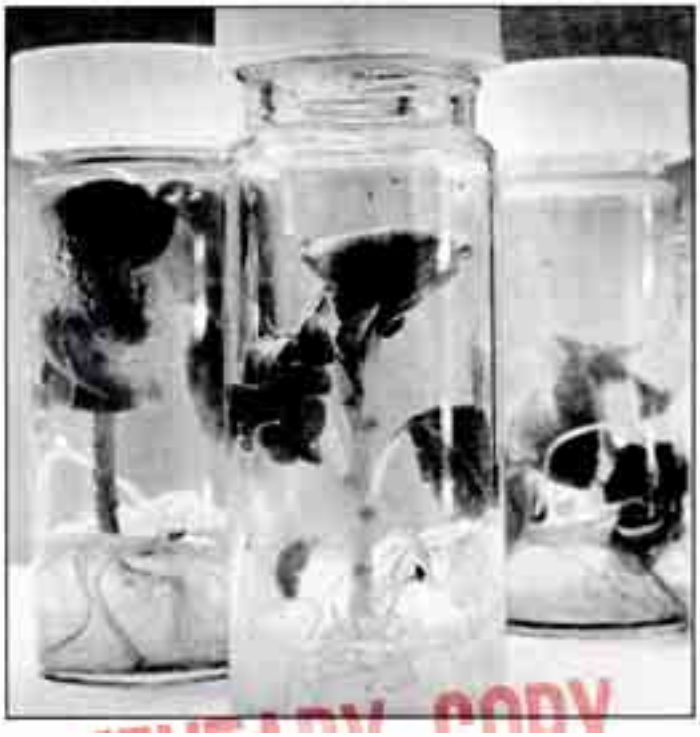

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CAPITOL VIEWS

Reagan Administration Zeroes In On U.S. Agricultural Research System Capability; Concern Highlighted By Keyworth Visit To Beltsville Agricultural Research Center

The growing sense of urgency and importance the Reagan Administration is now placing on the current and future capabilities of the U.S. agricultural research system was highlighted by a recent visit from White House Science Advisor George A. Keyworth, II to the nation's premiere agricultural research facility at Beltsville, Maryland. USDA officials described the visit as "part of an ongoing assessment of the nation's agricultural capability."

Keyworth, the science advisor to President Reagan and director of the Office of Science and Technology (OSTP), was accompanied by USDA Assistant Secretary for Science and Education Orville G. Bentley on a tour of the Beltsville Agricultural Research Center (BARC). The visit included meetings with Agricultural Research Service (ARS) Administrator Terry B. Kinney and with ARS scientistswhose research utilizesvarious state-of-the-art agricultural technologies.

USDA Photo

Presidential Science Advisor George A. Keyworth II (seated) examines a device used to inject genetic material from one plant into cells of another plant. Keyworth, director of the White House Office of Science and Technology, recently visited the USDA Agricultural Research Center in Beltsville to underscore federal commitment to continued agricultural research excellence. Orville G. Bentley (standing, left), assistant secretary for Science and Education at USDA, and Gordon Wallace (standing), senior policy advisor, Office of Science and Technology, accompanied Keyworth.

U.S. Must Maintain "Competitive Edge"

The presidential science advisor told ARS officials that USDA and the Administration are assessing the United States' "competitive edge" in agricultural research and production and are examining ways of maintaining or increasing that edge. Keyworth stressed the need for ARS scientists to "harness new knowledge and technology" in order to increase productivity and efficiency and to maintain the dominance of American agriculture in world trade. He called the protection of the U.S. agricultural system against droughts, erosion, diseases and other natural problems "a fundamental task facing today's agricultural research."

Among the ARS research projects the presidential advisor examined during his tour of the BARC research facility were:

- **Anther culture** techniques being utilized by scientists working in the ARS Tissue Culture and Molecular Genetics Laboratory. The researchers told Keyworth that this technique provides a significant short cut in plant breeding because agronomists can now select desired traits from small amounts of tissue grown in the laboratory from pollen rather than rely on the relatively slow method of repeatedly back cross-pollinating plants to one parental line in order to obtain a variety that breeds true. They pointed to a rice variety with 42 percent more protein that has been found using anther culture methods.
- **Viroid research** in which scientists in the ARS Plant Virology Laboratory are using recombinant DNA technology to make copies of a viroid (the smallest known disease-causing organism) that causes a potato disease. The researchers explained that by having a plentiful supply of these "copies" available, scientists can alter the genetic makeup of the viroid's DNA to see how each change affect\ disease symptoms in plants.
- **Chromosome manipulation** through which ARS scientists are injecting whole chromosome\ from one plant into the cells of another. Researchers explained to Keyworth that unlike conventional gene-splicing involving a single gene, this genetic engineering technique can move all of the genes responsible for a major plant characteristic, such as drought resistance, in a single operation.

Agricultural Research System Gets the Message

Many observers interpreted Keyworth's highly visible BARC visit as another in a series of recent "messages" to the agricultural research establishment that the Administration is serious about acting on recommendations contained in last year's controversial OSTP/Rockefeller Foundation report on the U.S. agricultural research system (see DIVERSITY, no. 2, p. 7).

The report, *Science for Agriculture*, was highly critical of what it characterized as the "interinstitutional and interdiscipline tension, defensiveness and rigidity [exhibited by the federal/state/private sector components of the U.S. agricultural research system] at a time when institutional collaboration and flexibility, interdisciplinary efforts and a focus on scientific and technological problems are essential for progress."

The report recommendations called for a redirection in the Agricultural Research Service toward more basic research, an upgrading of the State Agricultural Experiment Station and land-grant college system and an intensified effort to attract top scientific talent to agriculture.

All Sectors Respond to Recent Criticism

Despite the initial negative response from many sectors of the agricultural research community, the OSTP panel's hard-hitting recommendations have had considerable impact across the board in a surprisingly short time. Many see the new six-year (1984-1990) Strategic Plan for the Agricultural Research Service announced last spring by ARS Administrator Terry B. Kinney (see DIVERSITY, no. 4, p. 4) and a similar plan ready for unveiling by the new USDA Cooperative State Research Service (CSRS) Administrator J. Patrick Jordan, as positive attempts to address the system's acknowledged deficiencies.

(Continued on next page)

Major Biotechnology Research Grants Program Slated For USDA In 1985

Proposed funding of $28.5 million for the Cooperative State Research Service (CSRS) Competitive Research Grants program to launch a major initiative to study agricultural applications of biotechnology is a significant part of the FY 85 USDA budget the Reagan Administration recently submitted to Congress (see box).

Assistant Secretary for Science and Education Orville G. Bentley and CSRS Administrator John Patrick Jordan underscored the critical importance the Administration places on the potential the new technology holds for agriculture in recent testimony before Congress. "It is the *only* new initiative in the Federal budget for the life sciences," they told members of the House and Senate agriculture committees.

Bentley explained that although scientists have a better understanding of how to achieve within about a decade improved crop plant varieties through complex crosses and backcrosses, they still need more knowledge of how the genes in a higher plant interact to create a valuable commodity. Noting that we have only identified approximately 60,000 expressed genes in a universe of millions of higher plants, the Assistant Secretary predicted that successful applications of biotechnology "will enable us to shoot with a rifle instead of a shotgun."

By "building new capabilities into the seed," biotechnology could "significantly increase farm efficiency, increase profitability of the American farmer, and help maintain our competitive edge in agriculture," Jordan commented.

USDA: The Link Between Traditional Disciplines and Biotechnology

The unusually widespread support for the new initiative- in spite of the urgent need to control federal spending- is based, Bentley told the congressional panels, on the recognition by agricultural science leaders that "biotechnology must be grafted onto the [traditional] system if it is to continue to make significant contributions."

The new CSRS Administrator stressed that scientists in the biotechnology disciplines will have to "rely heavily on traditional plant breeders and integrated farm system teams to package new products in ways that will be useful to farmers."

The U.S. Department of Agriculture, Bentley and Jordon told Congress, "can provide the leadership to link traditional disciplines with biotechnology."

The CSRS Office of Grants and Program Systems (OGPS), established last year, will administer the competitive grants program. Edgar Kendrick has been appointed Administrator of the OGPS. Kendrick, a plant pathologist who has had a distinguished career in the Agricultural Research Service had served as Acting Deputy Assistant Secretary, Science and Education for two years prior to the new appointment. He recently named Terry Pacovsky as the grants management officer of the OGPS. For further information, contact: Terry Pacovsky, Chief, Grants Administrative Management Program, Office of Grants and Program Systems, Room 112, West Auditor's Bldg,. Washington, DC 20251.

The FY 85 Budget and Plant Genetics

The FY 85 budget proposal for the Department of Agriculture includes the following:

- A 514.1 million increase for the Agricultural Research Service (ARS) which includes a $4.6 million increase for plant science, a portion of which will support research to "modify plant germplasm." The total proposed budget for ARS ($483.0 million) indicates funding of National Plant Germplasm System activities will remain at the FY 84 level ($13.8 million).
- A $11.0 million decrease in funding for the CSRS special research grants program does not affect support for CSRS germplasm resources activities which also remains at the FY 84 level ($902.000).
- A $15.9 million decrease in funding for the Animal and Plant Health Inspection Service (APHIS) still allows for a net increase of $3.3 million for plant quarantine inspection in the total APHIS budget.
- A $2.8 million decrease in the Agricultural Marketing Service budget could be offset by proposed legislation to increase by $0.3 million the fees charged to plant breeders who apply for protection under the Plant Variety Protection Act.

Keyworth Visit

(Continued from page 3)

Other recent indications of the serious reassessment being undertaken by all sectors of the U.S. agricultural research system include:

- The Administration's 1985 budget proposal to add $28 million to the CSRS competitive grants program for research in biotechnology (see story this page);
- A major "needs assessment" report on food and agriculture by the Joint Council on Food and Agricultural Sciences, recently sent to Congress by USDA Secretary John R. Block (see story p. 6);
- A publication on the recent convocation on *Genetic Engineering of Plants, Agriculture Research Opportunities and Policy Concerns* as well as other initiatives dealing with agricultural research issues that are being undertaken by the newly established Board on Agriculture of the National Research Council, National Academy of Sciences: and
- Private sector initiatives such as the Plant Breeding Research Forum series and reports sponsored by Pioneer Hi-Bred International, Inc. (see story p. 9).

Keyworth Urges Vigilance

In testimony before the House Committee on Science and Technology last month, as well as in recent addresses to the Agricultural Research Institute and the USDA/National Research Council's Board on Agriculture "Challenge Forum," Keyworth continues to emphasize the strategic importance of "maintaining and expanding the competitive edge of U.S. agriculture" and the need for mechanisms that will "insure the vitality of the nation's agriculture."

The presidential advisor tends to effectively gain both the interest and concern of each audience with an analogy between U.S. agriculture and the U.S. automobile industry: "Not only Detroit, but virtually all of us, ignored for more than a decade the ample warnings that our long-time technical superiority was increasingly being challenged. In today's world, we can't afford to take our economic domination in *any* field for granted."

For further information on the BARC projects reviewed by Keyworth, contact: Lloyd McLaughlin, USDA/ARS, Bldg. 005, Room 331, BARC-W, Beltsville, MD 20705, (301) 344-2720. Copies of the OSTP/Rockefeller Foundation Report may be obtained from: Public Affairs Office, OSTP, Room 357, Old Executive Office Bldg., Washington, DC 20506. ■

Experts Say Germplasm Improvement Programs Are Key To Future Food Productivity Increases

Increases in food productivity required to meet projected consumer and agricultural market needs of the 21st Centurv can be accomplished most efficiently by increasing the rate of improvement of crop plant germplasm, according to a draft report by U.S. germplasm experts to Agricultural Research Service (ARS) Administrator Terry B. Kinney. The one percent annual gain in yields of major U.S. food crops currently estimated falls "far short" of meeting our projected needs "if we are to provide consumers with food and fiber at reasonable prices, conserve natural resources for sustained production and compete in world markets," these agricultural experts warn.

The report is the result of an ARS-sponsored workshop convened last December at Beltsville, Maryland, to assess the integration of emerging technologies into plant germplasm improvement programs. The two-day workshop, attended by 30 leading federal, state and private plant sector scientists with expertise in germplasm utilization. focused on the development of methods and technologies for: (1) producing, identifying, and isolating useful genetic variation, and (2) utilizing that variation to improve germplasm.

Although the group restricted its considerations to higher plants, it assessed the entire range of current and potential technologies applicable to both cellular and whole-plant populations. The workshop also limited its objective to identifying the overall science and broad approaches needed for germplasm improvement as it was recognized that the priorities among specific research approaches needed will vary among commodities, species and production regions.

Major Constraints Identified

Workshop participants affirmed at the outset of their deliberations that "the foundation of crop productivity is the inherent genetic potential of the crops themselves." Their initial discussions centered on obstacles that currently impede the mutual efforts of traditional plant breeders and molecular biologists in meeting projected long-term crop production needs.

The scientists first identified the following problems as **"major constraints"** that now restrict the development of improved germplasm of major crops:

- **We do not understand the genetic structure and function of higher plants well enough to fully exploit existing technologies for plant germplasm improvement.**
- **We have a limited capability to integrate emerging genetic engineering technologies into existing programs.**
- **We need to create a research environment that adequately fosters the discovery of new and potentially useful tools and methods for germplasm improvement.**

Two days of intense debate and analysis resulted in the identification of four major research goals and priorities the group contends are required "to develop the information and technology necessary to accelerate the improvement of germplasm of higher plants." The draft report, entitled *Integration of Emerging Technologies Into Plant Germplasm Improvement Programs,* states the four goals given below, identifies the research approaches required to achieve each goal, and discusses the priorities and balance among those respective approaches:

GOAL A: Develop basic knowledge concerning the organization of plant genomes, gene structure and the regulation of gene expression by:

- **A-l-** determining how genetic information is organized on plant genomes:
- **A-2-** elucidating the organization and structure of plant genes:
- **A-3-** determining how genes are regulated, and
- **A-4-** developing methods to identify and isolate genes of interest.

To modify germplasm it is necessary to better understand the "genetics" of higher plants. Today this includes classical genetics, cytogenetics, plant breeding and molecular biological approaches. This means the potential exists to better understand how genes are put together, how they function and how they are regulated. Molecular biology suggests some intriguing possibilities, but there is no guarantee that once plant genes are understood at the molecular level, scientists will be able to apply what they know. Because of this and because there is so much to be learned it is necessary to sharply focus research efforts and to immediately look for useful applications.

The workshop placed highest priority on the integration of molecular biology with whole plant physiology, genetics and breeding to study the regulation and control of specific traits of interest (A-3). This requires the judicious selection of traits and species and extensive coordination among a number of disciplines. Ideally, it will include federal, state and private cooperation, also.

The committee further recognized the need to understand: the organization of information in plant genomes **(A-1);** the organization and structure of plant genes **(A-2);** and to devise much more efficient means for identifying and isolating genes **(A-4).** This research should provide a background of useful information. The committee advised, however, not to wait for extensive work in these areas before exploiting information and techniques now available.

GOAL B: Develop more efficient methods for the identification and transfer of desirable genes between and within species by:

- **B-l** -increasing efficiency and effectiveness of methodology for hybrid production and utilization;
- **B-2-** Increasing knowledge and efficiency of genetic recombination:
- **B-3-** providing methodology to produce and utilize mutations as needed:
- **B-4-** increasing knowledge, efficiency, and effectivenessof methodology for cell culture and plant regeneration:
- **B-5-** developing vector-mediated gene transfer technology.

Elucidation of the mechanisms involved with recombination **(B-2)** appear to be of paramount importance since these are the primary constraints that limit modification of current breeding practices. An understanding of these phenomena should facilitate improvement of practices already well developed.

Research Goats Identified

Research directed to the acquisition of regeneration protocols for the economically important crop species **(B-4)** and the development of vectors useful for the *in vitro* manipulation of DNA and its insertion into cells **(B-5)** are of equal importance. The low probability, however. of their making a profound immediate effect on crop improvement techniques prompted the committee to ascribe slightly less priority to these approaches than those of **B-2.** The committee also pointed out that, while approaches **B-4** and **B-5** have considerable potential impact to crop improvement, success in this area will require a thorough understanding of gene structure and the mechanisms which regulate their organization in the genome and their expression.

Approach **B-l** would lead to improvement of current methods for crop improvement, although it was felt that the technology in this area was reasonably advanced. Mutation breeding has been of limited use in previous efforts toward crop improvement. While it could serve an increased role in providing new genetic variability, the most significant gains would appear to be possible after effective means to selectively modify given traits have been developed, and these may be facilitated by development of approaches **B-4** and **B-5.**

GOAL C: Develop effective and efficient selection methodologies for modifying traits associated with genetic improvement of plants by:

- **C-l** -improving the efficiency of current selection criteria for traditional agronomic traits:

(Continued on next page)

Improved Germplasm
(Continued from page 5)

- **C-2-** developing selection criteria for enhancing productivity in stress environments:
- **C-3-** developing screening procedures to make genetic changes in physiological and biochemical processes that contribute to the productivity of plants;
- **C-4-** developing methods for screening for desired traits in mofified organs and tissues;
- **C-5-** devising approaches for selection of useful traits in callus culture or at the cellular level:
- **C-6-** devising approaches for insertion of useful genetic characteristics into various cellular genomes and develop appropriate vector systems for those genomes.

GOAL D: Develop effective reproductive and propagation systems by:

- **D-l** -studying basic reproductive biology:
- **D-2-** manipulating modes of reproduction and propagation to develop and evaluate hew gene combinations;
- **D-3-** utilizing novel reproductive methods to propagate new cultivars;
- **D-4-** determining cytoplasmic and chromosome manipulations to develop new gene combinations;
- **D-5** -developing cell culture as a reproductive system for producing or maintaining new genetic combinations.

Research on control of modes of reproduction and propagation can significantly increase crop productivity. For example, production and utilization of sorghum increased dramatically after research on *sterility control* changed it from a self- to a cross-pollinated crop. New genetic methods offer almost unlimited potential for changing reproductive systems and the economics of cultivar development and use.

Balance Needed Between Basic and Applied Research

A balance between basic and applied research over a range of crop species is needed. Determination of priorities, balance and timing among research approaches vary with species and require input from ARS and state research scientists, industry representatives and crop advisory committees on a crop by crop basis.

Interdisciplinary interaction via formation of research teams (potentially including state, federal and industry personnel) at one location, and via strong linkages and communication among research scientists at different locations is strongly encouraged.

Report Details Benefits To Be Gained From "Research Users"

An appendix to the draft report describes in detail the designated research approaches required to meet each goal and identifies the disciplines and/or scientific expertise: special facilitiesand equipment; environmental requirements: and the organizational structure that would be required. The report also identifies the immediate "research users" whom would benefit from the research described.

The draft report states that the development of this information "will enable [researchers] to more efficiently and effectively modify both quantitative and qualitative traits that control yield potential, product quality, resistance to pests, tolerance to environmental stresses, and adaptation to economical, cultural, harvesting, handling, and management practices." The final report should also serve to "provide sound guidelines to agricultural administrators and policy makers considering priorities and balance on plant germplasm improvement research," according to Philip A. Miller, National Program Leader for Fiber, Oil and Tobacco, USDA/ARS, and chairman of the National Program Staff Steering Committee that organized the workshop.

For further information, contact: Philip A. Miller, ARS, NPS, Bldg. 005, Rm. 204, Beltsville, MD 20705, (301) 344-2725.

Workshop Steering Committee members: H. J. Brooks, USDA/ARS NPS, Horticulture, Sugar Production, Beltsville Md.: G. E Carlson, USDA/ARS NER. Acting Associate Area Director, Philadelphia Pa.. Quentin Jones, USDA/ARS NPS, Assistant to Deputy Administrator for Germplasm, Beltsville; P. A. Miller, USDA/ARS NPS, Fiber, Oil and Tobacco, Beltsville; C. F. Murphy, USDA/ARS, NPS, National Program Leader, Grain Crops, Beltsville; G.G. Still, USDA/ARS NPS, National Program Director, Crop Production, Beltsville.

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Acronyms used above:
ARS-Agricultural Research Service
NCR-North Central Region
NER-Northeast Region
NPS-National Program Staff
SR-Southern Region
WR- Western Region
USDA-United States Department of Agriculture

USDA Assesses Agricultural Research And Education Needs In Special Report To Congress

Citing research advancements in plant breeding as one of the critical "mainstays" of U.S. agriculture, a prestigious council of agricultural experts told Congress that the agricultural science and education system must continue to provide opportunities for crop plant improvement research in order to meet the global food demands projected for the year 2000.

That conclusion was contained in a massive "Needs Assessment" report by the Joint Council on Food and Agricultural Sciences recently presented to Congress by Assistant Secretary of Agriculture Orville G. Bentley. Bentley told the congressional panels reviewing the report that "tomorrow'sgain in scientific agriculture has its foundation in the strength and vitality of today's science and education community."

The needs assessment study is part of an ongoing effort by the U.S. Department of Agriculture and the Joint Council to meet the mandate set forth in the 1981 Farm Bill requiring USDA to improve the planning and research strategies governing the agricultural system.

The Joint Council report, based on an analysis of agricultural trendsduring the last two decades, finds that agricultural research, education and extension have brought about major increases in crop production-with two- and threefold yield increases in some cases-over the past 40 years. Of this gain, experts say half is attributable to improvements in the genetic characteristics of plants achieved through plant breeding. For the farmer-whose largest problem continues to be the high cost of production-this achievement represents a low-cost input, according to the Joint Council.

The remainder of the gains-resulting from better management practices such as nutrient supply enhancement, and improved weed control and much more timely production operations-are generally seen as high-cost inputs.

To the Joint Council. this data suggests
(Continued on page 8)

New Report Reveals Dramatic Increase In Private Sector Plant Breeding In Decade Following Passage of Plant Variety Protection Act

A survey of U.S. plant breeding companies reveals a "dramatic" increase in private plant breeding efforts between 1960 and 1979, according to an Economics Research Report (ERR) recently published by North Carolina State University. The findings, based on a survey of 214 seed companies, "leaves little doubt that the Plant Variety Protection Act (PVPA) passed by Congress in 1970 was effective in stimulating private investment in the breeding of varieties of soybeans, cereals and vegetables," states the report.

The PVPA established patent-like rights for plant breeders of non-hybrid crop species (see box). The stated intent of Congress in passing the law was to stimulate plant breeding research by providing incentives to private firms which were, in turn, expected to ultimately increase agricultural productivity. With a larger number of improved varieties being made available to farmers, legislators reasoned that increased competitiveness of U.S. agricultural products in world markets would follow. The larger investments in private breeding research were also expected to augment the efforts of public breeders, allowing the latter to concentrate on more basic research.

Questions Arise Over Impact of PVPA

Senate hearings in 1980 on proposed amendments to the PVPA and anticipated oversight hearings by Congress on the 1970 law have resulted in legitimate questions about whether these objectives have, in fact, been realized and what impact, if any, the Act has had on such issues as crop genetic diversity and seed price increases (see DIVERSITY, no. 1, p. 23). The ERR study is the first of several analyses of the PVPA to be released by public and private sector groups which attempts to address some of these questions. (Other such reports expected for public release soon have been undertaken by the American Seed Trade Association, USDA and the University of Wisconsin Department of Agricultural Economics. and the Environmental Policy Center.)

The ERR study's limited objective, according to authors, R. K. Perrin, K. A. Kunnings, and L. A. Ihnen, was to determine the general effect of the Act on expenditures on crop breeding by the private sector and the specific effect on the availability and productivity of soybean varieties.

Incentives and Expenditures On the Rise

The substantial increase in private plant breeding efforts revealed in the ERR survey results "suggests that plant variety protection should indeed create incentives for private breeding of non-hybrid crop varieties," though the report says these incentives should be considerably less than those for hybrid crops with similar demand. The difference, explain the authors, is based on the fact that buyers of hybrid seed must return to the plant breeders to purchase new seed each year, whereas buyers of non-hybrid seed can retain seed from their own crop.

Almost all of the corn and sorghum seed currently planted are hybrids produced by private companies, whereas most commercially planted varieties of soybeans, wheat, and other cereals have been developed, until very recently, by public plant breeders working through the USDA or university system. The ERR survey indicates that although private breeding research on soybeans and cereals is still small compared to that for hybrid corn and sorghum, the number of private breeding programs in soybeans and cereals grew from only a half dozen in the early 1960's to approximately 30 in the late 1970's.

The ERR research also determined that private research expenditures for breeding these latter crops grew significantly: from essentially none in 1960 to about $8.5 million by 1979. Total reported crop breeding research expenditures in 1979 by the 59 firms responding to this part of the survey totaled about $47 million. (The authors note that their survey tends to confirm University of Minnesota agricultural economist Vernon Ruttan's estimate of $60 to $155 million for private plant breeding research expenditures for the same year.)

> ***"The survey. leaves little doubt that the PVPA passed by Congress in 1970 was effective in stimulating private investment in the breeding of varieties of soybeans, cereals, and vegetables."***

Based on the significant increase observed in the number of private soybean breeding programs-and the research funds committed to these programs after 1970-the authors reasoned that a more rapid rate of variety improvement could be expected. They decided to examine university-sponsored soybean variety trials in three major soybean-producing-areas. (North Carolina, Iowa and Louisiana) in order to confirm this. Their examination showed that the number of varieties being tested grew from about 30 during the early 1960's to nearly 150 during the late 1976's.

An analysis of the yields of these varieties indicated that during the 1970's new soybean varieties released each year yielded about 0.12 bushels per acre more than varieties released the previous year, whereas there was no trend at all in the yields of new varieties released in successive years prior to 1970.

These findings offer further evidence, according to the authors, of the positive impact of the PVPA on soybean breeding. Although agricultural productivity has probably not as yet beengreatly affected by increased breeding research, the authors conclude that "there is every indication that soybean productivity will

(Continued on next page)

Facts On The Plant Variety Protection Act

Some of the significant features of the Plant Variety Protection Act (Public Law 91-577), as amended in 1980, are:

- **Rights conferred.** The owner of a protected variety has the right toexclude others from selling, reproducing, importing or exporting the variety for a period of 18 years (Sections 83, 111).
  - **Exceptions:** It is not an infringement of these rights to:
    (a) save seed for use on the producer's farm (Section 113), or
    (b) use and reproduce a protected variety for plant breeding or other bona fide research (Section 114).
  - **Limitation:** If an owner does not supply "public needs" for the variety at a "fair" price, the Secretary of Agriculture may declare the variety open to public use (with "equitable remuneration" to the owner) if this is necessary to insure an adequate supply of food and fiber (Section 44).
- **Assignment of rights by owner:** Plant protection has the attributes of personal property and the rights may be transferred by sale or licensing (Section 101).
- **Remedy for infringement of rights:** Remedy -for infringement is by civil action for damages.
- **Eligibility of varieties for protection:** To be eligible, a variety must have these properties:
  (a) distinctness in some identifiable characteristics from all prior varieties of public knowledge.
  (b) uniformity in the sense that any variations are describable, predictable and commercially acceptable, and
  (c) stability when sexually reproduced, in terms of retaining distinctive characteristics (Section 41).
- **Establishment of eligibility:** The breeder's description of the variety is sufficient to establish that the eligibility criteria are met. No field trials are necessary.
- **Exempted plants:** Section 144 exempted okra, celery, peppers, tomatoes, carrots and cucumbers, but these exemptions were repealed in 1980. Section 42 exempts first-generation hybrids, fungi and bacteria.
- **Repository seed samples.** Viable samples of seed must be deposited and replenished periodically in a public repository (Section 52).

PVPA

(Continued from page 7)

be affected as these varieties are adapted by farmers."

The authors make clear that other important issues related to the desirability of the Plant Variety Protection Act were not within the scope of this study. These include the effects of the PVPA on the genetic diversity of crop varieties, the exchange of breeding materials among plant breeders and the concentration of firms and price enhancement in the seed industry. The other government and private sector studies referred to above are expected to analyze these particular issues in detail. DlVERSITY will report on them as they become available.

Copies of the report, "Some Effects of the U.S. Plant Variety Protection Act of 1979," Economics Research Report No. 46, can be obtained from: R. K. Perrin, Dept. of Economics and Business, North Carolina State University, Raleigh, NC 276.50, or from The American Seed Trade Association, 1030 15th St., NW, Suite 964, Washington, DC 20005. ■

The PVPA and Genetic Diversity

A brief analysis included in the ERR study of the Plant Variety Protection Act's impact on genetic diversity discusses the two major issues of concern raised during congressional hearings on the 1980 amendments to the Act:

"With respect to genetic diversity, concerns have been expressed about two possible effects of any successful crop breeding effort. The first effect is that farmers and gardeners cease to plant their traditional varieties, with the result that the existing pool of germplasm may be lost. The second effect is that the discovery of a superior genetic strain might quickly lead to the incorporation of this strain into many, if not most, of the commercially successful varieties of a crop, thus increasing the genetic vulnerability of the crop as a whole.

"It is clear that both of these effects are undesirable, though their magnitude and significance are subject to much disagreement. As the National Academy of Science's study ("Genetic Vulnerability of Major Crops," 1972, p. 129) noted, however, it would be 'unthinkable that we would deliberately revert to less productive types of varieties merely for the sake of preserving farmers' seed,' when the alternative is to increase efforts to collect, store and preserve germplasm. It would seem to be almost as unthinkable to revert to significantly less productive varieties just to reduce genetic vulnerability by some unknown amount.

"Both of these effects of successful crop breeding are perplexing problems and it is not clear how the PVPA would exacerbate them. One argument offered is that the Act will result in less genetic diversity because of the genetic homogeneity required to meet the distinctness and uniformity criteria for protection of a specific variety. This argument is not very convincing because the uniformity required for plants within a new variety in no way implies uniformity across new varieties. The relationships between PVPA and the issues of genetic diversity and genetic vulnerability would seem to require more careful examination."

Special Report

(Continued from page 6)

that "crop research can significantly contribute to increases in agricultural productivity" by two primary means:

- the genetic potential for high yield can be improved: and
- yields can be improved in unfavorable environments.

Genetic Engineering Boost To Crop Improvement

In addition to traditional plant breeding approaches to crop improvement, the Council says the application of genetic engineering techniques will be important for enhancing agricultural production in the future.

The barrier to a rapid application of molecular genetics to higher plants, according to the report, is our lack of understanding of gene expressions. Consequently, while it is possible to identify genetic elements, increase their quantity and incorporate them into a target plant, the report says, the expression of the new genetic material "has been achieved only with great difficulty, and our understanding of how genes are turned on and off is still rudimentary."

The report cites two recent and radical changes in scientific understanding that increase the potential for these new approaches: (1) the "revolution" in our knowledge of molecular genetics which could not have been predicted as recently as 1969: and (2) the increase of our understanding of how plants cope with unfavorable environments. Effective agricultural applications of these techniques, assert the Council, are now "within reach."

The Council report asserts that our ability to apply these potentially revolutionizing techniques resides largely in the capabilities of ourgermplasm system:

Obviously, basic to the application of these new technologies is the need for a wide diversity of genes that can be incorporated into crop germplasm. The continuing loss of wild genotypes and land, together with increasing population pressures worldwide, places particular importance on the need for more activity in plant exploration, mutation, and advanced techniques for recombination. Central to each of these activities is the need for germplasm conservation and evaluation. Such research is long term and of high risk but of inestimable value for plant breeding and for exploring the fundamental behavior of crops.

The section of the report dealing with crop production needs targets the following as "promising" areas of molecular genetics to increase crop productivity: biological stress, plant regeneration, physiochemical stresses, photosynthesis, nitrogen fixation, male sterility and seed proteins.

In addition to the detailed analysis of how agriculture's science and education system can impact crop production and protection problems, the 328-page Joint Council report assesses the following areas: natural resources: animal production and protection: processing, marketing and distribution: human nutrition: consumer programs: agricultural policy and international activities. Another major section of the report explores in detail such issues as developing scientific expertise in agriculture and the applications of biotechnology, information systems and computer technology to agriculture.

For copies of the Joint Council Needs Assessment Report and Summary Report, contact: Larry R. Miller, Executive Secretary to the Joint Council, USDA, Rm. 352-A, Administration Bldg.. Washington, DC 20250, (202) 447-8662.

Kellogg Grant Establishes New Agricultural Policy Center

The establishment of a National Center for Food and Agricultural Policy was recently announced by Resources for the Future, Inc.. an independent, nonprofit research and educational organization based in Washington, DC. The Center's activities will focus on national public policy issues concerning America's agriculture, food production and use. Initial funding for the Center came from a $4.5 million grant from the W. K. Kellog Foundation.

"The United States faces an array of problems concerning the future of its agriculture and its food supply. Public policy about agriculture, international trade, food and environmental protection must be well-designed, appropriate and sound. The alternative to that is not acceptable," said Robert Kramer, a Foundation program director, when presenting the grant.

The Center will be headed by Kenneth R. Farrell, a former administrator of the Economics and Statistics Service of the USDA. For further information, contact: Resources for the Future, Inc.. 1755 Massachusetts Ave., NW, Washington, DC 20036, (202) 328-5000. ■

NPGS NETWORK NEWS

Plant Breeding Research Forum Persuades Legislators Of Critical Need To Support National Plant Germplasm System

Recent high-level briefings in Washington, DC. conducted by the second Plant Breeding Research Forum brought closer to fruition the long-time objective of all those involved with plant genetic resources: recognition and support for the National Plant Germplasm System as a major national program on which our economy and security depend.

Members of Congress and their staffs, top officials from the executive branch of the federal government, and representatives of major public and private interest groups heard warnings by a Forum delegation that America's abundant food supplies are at risk because our crop varieties lack sufficient genetic diversity.

The briefings centered on a series of recommendations (see box) formulated at the Plant Breeding Research Forum's meeting of selected public and private sector plant specialists last summer (see DIVERSITY. no. 5, p. 8). That conclave was the second of a three-part Forum series sponsored by Pioneer Hi-Bred International, Inc.. established to identify food supply issues related to plant breeding and to increase awareness of major scientific challenges facing the future of American agriculture (see DIVERSITY, no. 4, p. 4).

Experts Call for Major Funding Increases to Support NPGS

"The preservation and evaluation of germplasm should have top priority," urged William L. Brown, chairman of the Forum. "Without plant germplasm, soil, water and air are useless in food and fiber production."

Citing the importance of "our fourth natural resource," Quentin Jones, head of the U.S. National Plant Germplasm System. told officials that "plant germplasm is an extremely valuable resource which can never be replaced if lost."

Brown said that in order to properly evaluate, store and maintain the thousands of germplasm samples already collected, "the storage facilities and procedures of the U.S. National Plant Germplasm System must be re-evaluated and drastically improved. . . This can only be done if budget needs are fully met."

"Considering the annual value of U.S. crops is about $80 billion," Jones reported, $40 million [one five-hundreth of one percent of the annual value of America's major crops] seems like a reasonable price to pay for conserving the foundation of the world's future food supplies."

The Washington, DC Forum delegation-including Brown. Jones, Charles Rick (University of California-Davis) and Major Goodman (North Carolina State University)-used effective illustrations throughout the briefing sessions to focus public attention on some of the urgent needs of the National Plant Germplasm System.

> *" the delegates compared most germplasm banks to pharmacies filled with unlabeled 'wonder drugs' "*

For example, the Forum delegates compared most germplasm banks to "pharmacies filled with unlabeled 'wonder drugs"' and likened the dearth of genetic diversity utilized by plant breeders to "a card game in which only a few cards- the same ones-are constantly reshuffled to produce new combinations. Failure to use the complete deck makes it increasingly difficult to produce new combinations that are uniquely different from existing ones," they explained.

Response Seen as "Significant"

Those attending the various Forum presentations during the two-day briefing included representatives from the House and Senate agriculture and appropriations committees, the Department of Agriculture, the Office of Management and Budget, the Office of Science and Technology Policy, the Congressional Research Service, the Office of Technology and Assessment, the National Science Foundation, the National Academy of Sciences, the American Seed Trade Association, the Agricultural Research Institute and numerous environmental and commodity organizations,

Skip Styles, on the administrative staff of the House subcommittee on agricultural research, and a long-time proponent of increased support for the National Plant Germplasm System, said he was gratified that the issue of plant genetic resources-and its critical relationship to our agricultural capabilities- was" finally receiving the long-overdue and serious attention that it merits."

Evidence of this attention was almost immediate as congressional staff began formulating possible legislative proposals that could funnel money into the germplasm system. Sources say one such proposal, favored by the Reagan Administration, would call for a user fee tied to improved, evaluated germplasm. Under this proposed scenario, "raw" or exotic germplasm would be freely available.

Though these and other proposals will be subject to stringent debate, many see as significant the fact that Capitol Hill has moved so quickly on the issue.

The topic for the 1984 Forum will be "Exploring Genetic Engineering Techniques." For further information and copies of the 1982 and 1983 Forum Reports, contact: Gordon McCleary, Capital Square, 400 Locust, Des Moines, IA 50308, (515) 245-3500. ■

Plant Breeding Research Forum Targets Priorities For Action On Plant Germplasm

- The establishment of a National Technical Advisor on Germplasm within each Crop Advisory Committee is needed in order to clearly place on one person the responsibility for the advancement of germplasm.
- A review of the status of national plant germplasm collections is one of the first projects that should be undertaken under the direction of the Technical Advisors on Germplasm.
- The evaluation of germplasm collections must receive very high priority.
- Information gained through evaluation will enable those responsible for plant germplasm to pinpoint areas of the world where additional collections should be made.
- Innovative approaches must be taken to stimulate the enhancement or "pre-breeding" of germplasm.
- Funding for the National Plant Germplasm System should be increased to meet the needs projected by the system's administrators. (Projected funds needed are placed at $32 million for FY 85, $36 million for FY 86, $38 million for FY 87 and $40 million for FY 88.)
- Quarantine regulations applying to plants and seeds should allow enough administrative flexibility to permit germplasm transfer so long as it is done under proper supervision and does not pose a clear threat to crops in the importing country.
- Because of theglobal nature of germplasm, the United States should set an example for other nations in cooperating with the International Board for Plant Genetic Resources and the international agricultural research centers of the Consultative Group on International AgriculturaI Research.

Germplasm Resources Information Network Now Available To Scientific Community

Information regarding the location, characteristics and availability of germplasm accessions within the U.S. National Plant Germplasm System (NPGS) is now available to all *bona fide* scientists through the Germplasm Resources Information Network (GRIN), according to Agricultural Research Service (ARS) officials.

The long-awaited and much-anticipated USDA database management system (see DIVERSITY, no. 4, p. 6 for background) is seen as having three important functions to fulfill. First, it will serve as a central repository of valuable germplasm information that is accessible by the entire germplasm community. Second, it will be a means for the Crop Advisory Committees to compile standardized plant characteristic data. Third, it will provide a mechanism for each Regional Plant Introduction Station and other curatorial sites to maintain their inventory and other operations information.

Supply and Demand User Groups

GRIN will serve two broad groups of "information users" that were identified as a result of a rigorous analysis of the diverse needs of the germplasm community. One group, the "suppliers," consists of those who acquire, maintain, and distribute germplasm and data, such as curators and staff of the National Seed Storage Laboratory introduction stations. A second, or "demand" group, are those who use the germplasm resources and data, such as plant breeders, scientists and researchers.

Basic system features within GRIN include computer software programs that will support "supply" and "demand" groups. For the supply group, features are available which record the introduction of new germplasm samples into the NPGS: retrieve passport information, such as country of origin and taxonomic classification: trace the accession's pedigree: and detail any reported attributes such as susceptibility or resistance to insects or disease. The production of an annual Plant Inventory catalog will also be supported.

System To Incorporate Information Updates

Curators maintaining working collections will be able to automatically update seed inventories to reflect orders placed, monitor viability of accessions, process seed orders, and exchange information with other curators electronically.

Planned refinements will also assist in germplasm evaluation efforts by giving sites the capability togenerate field books for recording evaluation data. These books will contain standardized plant descriptors recommended by a Crop Advisory Committee (CAC) (or defined for a particular evaluation if different from the CAC list). Information collected will be entered into GRIN for public use. Summary reporting features available to curators will produce seed lists in a standard format for broad public dissemination with the option for more tailored reports to be generated by the regional station's own staff.

The "demand" group will be able to query the database and create files of information on accessions. including characteristic data, use, and location within NPGS. Users will then be able to order accession samples from the curator sites and/or generate tailored reports according to their needs.

GRIN To Centralize All Pertinent Information

The GRIN database, housed within the ARS Plant Genetics and Germplasm Institute at Beltsville, Maryland, and managed by the Database Management Unit (DBMU), will link together in one location most of the pertinent information about a particular germplasm accession - from its native habitat to the most recent characteristic and evaluation results.

This centralization will also allow researchers access to a more extensive collection of samples from which to choose, thereby reducing the possibility of overlooking the inventory of a potentially valuable collection. Maintenance of information is supported through automatic updates that are quickly available to everyone. The most accurate and current information is thus accessible without time-consuming notifications.

System Will Accommodate Changing Needs

System updates will be made by recognized experts in a particular area. For instance, plant taxonomists will monitor and maintain taxonomic nomenclature, the Plant Introduction Office will maintain information concerning the accession's origin and particulars about its introduction. the regional plant introduction stations and other curators will maintain viable samples and coordinate their distribution, and the breeders, growers and researchers will assist in providing evaluation and characteristic information.

DBMU specialists say GRIN has been designed to accommodate the growth of the NPGS and the changing needs resulting from that growth. Anyone who can justify a need for accessing the database can obtain permission to use the system. Access to the database can only be gained by submitting a request to the DBMU and obtaining a log-on and password assigned for the prime computer on which GRIN is contained. An additional password is required to access the database.

According to DBMU personnel. a user will find it essential to understand some basic principles of a database management system as well as the diagram of the GRIN data model, which presents a pictorial view of how information contained in GRIN are related. These topics are thoroughly discussed in the GRIN Data Retrieval User Manual. For further information. contact: Allan Stoner or Jim Mowder, Plant Genetics and Germplasm Institute, Bldg. 001, BARC-West, Beltsville, MD 20705, (301) 344-0235 or 344-3318. ■

In Memoriam

Clarence O. Grogan, executive secretary of the National Plant Genetic Resources Board since I970 and a member of the National Plant Germplasm Committee, died suddenly of a heart attack on October 30, 1983. A member of USDA's Cooperative State Research Service since 1976, Grogan had recently completed an assignment as acting chief of the Competitive Grants Office and acting associate director of the Office of Grants and Program Systems. Grogan had also served as group leader and assistant deputy administrator of plant science and chaired the USDA Committee on Recombinant DNA.

Prior to joining USDA, Grogan was a professor of plant breeding at Cornell University for ten years and was a member of the Cornell graduate faculty for international and rural development. He was a fellow of the American Society of Agronomy and a member of the American Genetics Association.

In comments eulogizing Grogan, CSRS Administrator John Patrick Jordan said, "Clarence brought certain competencies to CSRS which will be extremely hard to replace. He was a true gentleman in every sense of the word. He will be truly missed by all of us in CSRS, the Department of Agriculture and many of you in the research community." ■

SOHIO Grant Establishes U. of I. Crop Genetics Research Center

A $2 million grant from the Standard Oil Company of Ohio has enabled the University of Illinois (U. of I.) to establish a Center of Excellence for Crop Molecular Genetics and Genetic Engineering. The Center will focus on basic research to improve major field crops, particularly corn and soybeans.

The U. of I. was one of five universities selected by SOHIO to receive research awards through its $10 million "Centers for Scientific Excellence" program and the only university chosen to work in the areas of biotechnology and agriculture.

"SOHIO recognized both the need to foster communication between public and private sector plant research scientists and the serious shortage of trained professionals in this area," University of Illinois Experiment Station Director Donald Holt told DIVERSITY in an interview, "and the grant will be directed toward addressing these needs."

A significant portion of the funding-to be expended over a five-year period-will support four postdoctoral personnel, 12 graduate students, and four undergraduate students. The shrinking of agricultural budgets has resulted in the continued erosion of support for graduate students, according to Holt. The emphasis on support for training in the SOHIO grant "is a welcome step in the right direction," he asserted. The Center has also established a joint SOHIO/U. of I. management committee which is expected to strengthen the liaison between public and private sector research activities.

The activities of the SOHIO/U. of I. 'Center of Excellence" will be conducted by five principal investigators currently working in the U. of I. Agronomy Department: one scientist who will fill the newly-created position of SOHIO Professor of Crop Molecular Genetics: 15 collaborators and one instrumentation specialist. Principal investigators whose research activities will involve incorporating special traits from exotic germplasm into domestic varieties, gene transfer mechanisms and tissue culture techniques, include U. of I. professors: Jack Harlan, Johannes de Wet, Ted Hymowitz and Jack Widholm. William Ogren, a USDA/ARS physiologists, will also serve as a principal investigator.

U. of I. Dean of Agriculture John Campbell said a worldwide search is underway for a distinguished professor of crop molecular genetics to serve as the Center's administrator. The participants hope to fill the position by mid-summer.

For further information about the Center or application requirements, contact: Ted Hymowitz, Department of Agronomy, University of Illinois, 1102 S. Goodwin Ave.. Urbana, IL 61801.

USDA Issues Guidelines For Peanut Germplasm From Foreign Sources

In response to a recently identified peanut stripe virus affecting U.S. crops (see DIVERSITY, no. 5, p. 20), guidelines for recipients of peanut germplasm from foreign sources were approved by the Peanut Crop Advisory Committee, the USDA Southern Regional Plant Introduction Station, S-9, and the Plant Introduction Office and jointly released in early 1984. The guidelines are as follows:

Quarantine restrictions will likely be imposed by the Animal Plant Health Inspection Service (APHIS) on peanut seed imports from People's Republic of China because of the recent outbreak of peanut stripe virus. A quarantine import permit will probably be required.

Persons who receive peanut seeds direct from foreign sources should send seed and associated information to the USDA Plant Germplasm Quarantine Center, Bldg. 320, BARC-East, Beltsville, MD 20705, for proper inspection. After inspection, the Plant Introduction Office at Beltsville will handle documentation and appropriate distribution.

Recipients of inspected original seed from foreign sources should take all *precautions* to reduce the probability that a new disease (fungus, bacteria, virus, nematode) or insect pest will become established when accessions are grown. The recommended precautionary steps are outlined below.

- Examine seed carefully for visual evidence of disease or insects. Accessions obviously infested should be increased in the greenhouse (screenhouse). Treat all seed with locally recommended seed treatment.
- Field isolation of at least 200 meters from other plantings of peanut is recommended forgermplasm introduced from another country the first time it is grown in the U.S.
- All plants from seed produced outside the U.S. should be examined by a qualified scientist(s) a minimum of four times during the first growing season. The first examination should be made 46 weeks from planting and the last should come within IO days of harvesting.
- When unfamiliar symptoms appear, consultations should be held with other scientists who are qualified to give advice. Appropriate steps must be taken to prevent the establishment of new diseases in the U.S. Privilege study of a new disease by the inspecting scientist is customary.
- Plants with symptoms other than those caused by established organisms should be pulled up and placed in an appropriate container immediately, and autoclaved a minimum of 20 minutes at 121° (15 p.s.i.).
- If unfamiliar symptoms are observed on introduced germplasm, observations should be communicated to the Plant Introduction Office as soon as possible so other recipients can be warned of potential problems.

Industrial Pollution: New Challenge For Plant Scientists

The effectsof industrial pollution may challenge plant researchers to determine the susceptibility of cantaloupe and watermelon cultivars to air pollutants.

Melon crop losses in the Vincennes, Indiana, area during the 1983 growing season point toward air-pollutant-induced damage. In reports following field surveys, ARS plant pathologists state ".. it is apparent that ozone and possibly ozone in combination with sulfur dioxide caused much of the injury observed. Injury to the 1983 melon crop was quite severe and. because of diminished marketability, substantial economic losses must have been sustained by growers."

Much of the melon-growing region is bounded by six or seven electricity-generating power plants. Total melon acreage in the area ranges from 10,000 to 12,000 acres with grower loss estimated from 25 to 100 percent in fields showing moderate to severe injury.

Recommendations proposed by ARS plant pathologists for the 1984 growing season include expanding field survey and monitoring operations: beginning the evaluation of *Cruciferaceae* cultivar susceptibility to air pollutants: and examining the relationship of management practices to the injuries sustained, field location, power station activities and meteorological conditions.

Dr. Richard A. Reinert, USDA plant pathologist in Raleigh, North Carolina, and one of the scientists investigating the problem last summer, told DIVERSITY, ". part of the difficulty lies in the fact that air and our government's regulation of it is a rather new field. If one looks at the total problem, the question must be asked, Do we address the problem from a plant improvement and basic research aspect to solve it or do we work with industry to regulate the problem:'"'

In response to this situation, ARS has provided $150,000 in FY 84 extramural funds to Purdue University's Department of Horticulture to examine the specific pollutants contributing to the problem during the upcoming growing season. and, once determined, to associate the effects of the identified pollutants on melon production.

For more information on this project, contact: B. C. Moser, Horticulture Department, Purdue University, West Lafayette, IN 47906, (317) 494-1306. ■

Miami Avocado Germplasm Collection: An International Resource For Plant Breeders

The avocado germplasm collection maintained at the USDA/ARS Subtropical Fruits Clonal Repository at Miami, Florida, is a resource of international importance. The repository holds the most extensive avocado collection in the United States, containing 170 clones collected from all parts of the world where this crop grows.

Southeastern Florida's well drained high-pH soil makes a near-perfect growing medium for avocados because it is hostile to establishment of the lethal root rot fungus *(Phytophtohora cinnamomi* Penz.) which plagues avocado trees on heavier or more acidic soils, explained Robert Knight, research horticulturist at the Miami station. The warm subtropical climate at Miami also makes it possible to maintain the three ecological races of avocado as well as the hybrid groups, one of the most important of which (Guatemalan x Antillean) originated there.

The oldest trees in the collection, Guatemalan cultivars, collected by USDA agricultural explorer Wilson Popenoe in 1917, have grown in their present location for 60 years. Breakdown of the Miami collection by racial groups is as follows: Antillean (West Indian), 37.6%; Mexican, 22.4%; Guatemalan, 13.5%; hybrid Guatemalan x Antillean, 17.6%; hybrid Guatemalan x Mexican, 6.0%; Mexican x Antillean, 2.9%. The interracial hybrids, which make up over one-fourth of the collection, are of particular horticultural importance, according to Knight, because they combine superior fruit characters with seasonal and climatic adaptations found in different racial groups.

Among the avocado clones in the Miami repository are important cultivars such as Fuerte, Hass, Bacon, Booths 7 and 8, Lula, Monroe, Nabal, Sharwil, Simmonds, Waldin and Trapp. In addition a number of obscure clones included are of interest for their disease resistance, cold tolerance, or the basic information they may contribute to understanding the avocado's biology and its history and development as a crop. Among these are a small black-fruited tree blending Mexican and Guatemalan characters that was collected at Antigua, Guatemala, and also a group of nine clones from Ecuador (where they are called "Nacionales") that appear to be of Mexican race although they have been grown in Ecuador since pre-Columbian times.

Global Distributions Demonstrate Value

Germplasm distributions over the last 26 years (1958-1983) demonstrate the importance of the avocado collection as an international resource, said Knight. These total 880, of which about one-third were distributed in the five-year period 1979-83. The largest number of distributions (39.54% of the total) went to cooperators in Florida: the next largest (20.7%) to recipients in Africa. California ranked next, receiving 9.54% of all distributions, then South America (7.61%), Asia (7.5%) and the Caribbean Basin (6.02%). The continental United States (except California and Florida) plus Canada ranked next, receiving 3.06% of all distributions, slightly ahead of Mexico and Central America (2.61%) and the Pacific Basin (2.4%). The state of Hawaii received 1.02% of all distributions.

In addition to its value as a source of germplasm the Miami avocado collection has been useful to scientists working on this crop from varying viewpoints, Knight told DIVERSITY. Since 1967, 15 research publications that appeared in the United States and elsewhere have depended on data acquired from thisgermplasm collection. The Miami avocado repository also qualifies as a "working collection" because it is the source of cold-tolerant selections derived from evaluating Mexican race plant introductions maintained here. Promising selections from this work now are under test in parts of Central Florida and Texas where their performance will be evaluated pending further use of them in breeding or industry.

For further information, contact: Paul Soderholm, Avocado Collection Curator, USDA/ARS, Subtropical Horticultural Research Station, 13601 Old Cutler Rd., Miami, FL 33158, (305) 238-9321.

PLANT QUARANTINE ALERT

Scientists need to be aware of quarantine regulations that affect exchanges between them and cooperating foreign scientists. All too often, serious delays and misunderstandings arise because quarantine arrangements were not made before shipment of plant materials. George White and Sharon Kenworthy of the USDA Plant Introduction Office (PIO) offer suggestions for handling plant germplasm exchanges. By ,following these suggestions scientists will experience ,fewer delays and frustrations, and the movement of plant germplasm will be more efficiently expedited.

DO

- Share germplasm freely with other countries and with the National Plant Germplasm System (NPGS).
- Have all plant materials received directly from foreign sources inspected by quarantine officials.
- Apply for quarantine import permits when required from the Animal Plant Health Inspection Service (APHIS) at least six weeks in advance..
- Use the USDA Plant Germplasm Quarantine Center (PGQC) as a flow channel for imports and exports of experimental quantities of plant germplasm.
- Check with APHIS or PIO about quarantine status of specific crop species before initiating exchanges. This is especially critical for clonal materials such as *Malus, Prunus, Pyrus,* tubers of potato and sweet potato, and all highly perishable items.
- Ask the PIO to assist with exchanges of interest to you.
- Assist germplasm curators and PIO in identifying specialized germplasm of potential value to research programs and to germplasm collections.
- Provide complete mailing addresses of foreign recipients and detailed descriptive information about materials being sent.
- Request detailed information about materials to be received from foreign sources.
- Send copies of correspondence about plant germplasm exchanges to PIO and PGQC.
- Enclose identification of plant materials, sender, and recipient as well as any permits or special shipping arrangements with the plant material.

DON'T

- Plant any imported materials before official inspection and determination of quarantine status.
- Send or carry plant materials of any kind overseas without a phytosanitary certificate.
- Send clonal or highly perishable materials overseas without knowing the quarantine import requirements of the recipient country.
- Identify plant materials by common names (use scientific names).

For further information and copies of required forms, contact: George White, Plant Introduction Office, USDA/ARS, Room 322, Bldg. 001, BARC-West, Beltsville, MD 20705, (301) 344-3328.

U.S. Plant Exploration Efforts Result In "Very Promising" Potential New Crop For Third World Countries

The decision by ARS Plant Exploration Officer Robert Perdue to take up his own challenge by testing the demanding new plant exploration preparatory requirements he instituted last year (see DIVERSITY, no.4, p. 8; and no. 5, p. 7) may result in the development of a lucrative new industrial crop for the Third World.

Perdue's proposal to the Plant Germplasm Operations Committee last spring for approval of an exploration to acquire germplasm of *Veronia galamensis* and related species in Africa led to a January collection mission, supported by the Office of International Cooperation and Development. The trip included stops in Kenya (the center of genetic diversity for *V. galamensis),* Zimbabwe, Zambia, Tanzania and England. His observations convinced Perdue that *V. galamensis*- a new crop source of oil which shows potential as a raw material for the plastics and coatings industry-is "a very promising new crop" for production in tropical and subtropical semiarid areas.

ARS Reconsiders Vernonia Potential

The thorough preliminary research Perdue undertook-in order to answer questions now required by the ARS plant exploration proposal form-led Perdue to surmise that ARS may have "missed the boat" in the 1960's by prematurely concluding that *V. galamensis* was not adaptable for cultivation in the United States. Perdue discovered that one of the projects included in a major ARS new crops program initiated in the 1950's focused on the discovery of unusual seed oils. ARS scientists and economists had hoped that through this project industrial markets might be created to recapture markets lost by agricultural products to petrochemicals.

Perdue believes that the type of review and study now required in exploration and utilization projects would have revealed that the species did exhibit good natural seed retention (lack of which was the factor for failing to establish it as a new crop at that time); and the scientists would have concluded that *V. galamensis* would have performed well in the United States, especially in southern Texas and Puerto Rico-the initial objects of Purdue's recent interest.

Interest in *V. galamensis* for a new U.S. crop was rekindled when another potential source of Vernonia oil was successfully grown in Kenya and Puerto Rico and a substantial amount of seed oil became available in 1975 and 1981 respectively. With new reason to believe that *V. galamensis* held real potential as a new crop, Perdue decided another exploration for the African species (he had first collected germplasm in Ethiopia in 1964) would be worthwhile.

In a recent paper written prior to his departure, Perdue and his colleagues K. D. Carlson and M. G. Gilbert concluded that the contrast between growth in the dry environments of Kenya and Puerto Rico suggested that "development of *V. galamensis* as a new crop should be focused on semiarid tropical areas where rainfall is concentrated during four to six months followed by one or two months in which rainfall is practically nil." (The paper, "Vernonia Galamensis, a Potential New Crop Source of Epoxy Acid," by Perdue, Carlson and Gilbert, dated January 9, 1984, will be published in a future issue of *Economic Botany.)*

> ***" ARS efforts to establish Vernonia as a major new crop in Zimbabwe gives the United States a concrete opportunity to show how our programs can contribute to the Third World. "***

Their study also referred to research conducted by L. H. Princen which concluded that a natural epoxy oil source such as *V. galamensis* "could make a significant contribution toward supplying the 100-150 million pounds of epoxy oils used annually in the United States."These products are currently valued at $100 million per year based on epoxidized vegetable oil esters used as plasticizer stabilizers 'in the manufacture of PVC (poly vinyl chloride).

Princen sees the production of 10,000 acres of *V. galamensis* as a realistic starting point to establish a new raw material source for the plastics and coating industries, as well as for other potential uses that further research could reveal.

U.S. Supports Development in Zimbabwe

Why, then, with this very impressive potential, has Perdue recommended that Zimbabwe-rather than the United States-develop this new crop?

"If I had the total freedom to select an environment, both climatic and intellectual, best suited to pursue a cooperative program to develop Venonia as a new crop I believe I could recommend none better than Zimbabwe," Perdue explained to DIVERSITY in a recent interview. "I found competence at all levels. The country is heavily dependent on agriculture. There is desire for a new crop, enthusiasm that success can be achieved, yet enthusiasm tempered by cautious optimism. Soils in many areas, rainfall distribution and total rainfall are near ideal. *V. galamensis* has been collected in the eastern part of the country at Mutare and in adjacent Mozambique, and there is a good network of experiment stations."

Critical to Perdue's recommendation, however, was this fact: while production of the 10,000 acres estimated to meet the current market needs for Vernonia oil would still make *V. galamensis* a relatively minor crop with relatively little economic impact on American agriculture, such production on that scale could establish Vernonia as a major crop in a Third World country such as Zimbabwe.

If milling costs are moderate and the oil does not deteriorate in storage, Perdue says the prospects are good that oil can be extracted economically in the producing country and exported to markets in the United States and Europe. He believes that Vernonia can be established as a new crop in a country like Zimbabwe in a relatively short time.

The U.S. plant exploration officer told DIVERSITY that ARS efforts to establish Vernonia as a major new crop in Zimbabwe "gives the United States a concrete opportunity to show how our U.S. agricultural research programs can contribute to the Third World." Perdue thinks it is inevitable that "the propaganda of Pat Mooney (see story, p. 15) is going to be heard and heeded and that our arguments in rebuttal may have little impact. Nonetheless," he added, "deeds speak louder than words."

U.S. Contributes and Derives Benefits

Trial plantings for preliminary evaluation of *V. galamensis* are being conducted at four field stations in Zimbabwe in 1984 and will expand to include all stations in 1985 if the results justify. Perdue said U.S. support will continue when ARS scientist Gudrun Christenson departs for Zimbabwe in April.

Continued plant exploration must be undertaken to assemble additional germplasm of *V. galamensis* that may be needed to develop varieties with better insect, disease, and nematode resistance, and even better seed retention and drought resistence, said Perdue. He called Gilbert's in-depth classical taxonomic study of *V. galamensis* "reliable" and "an excellent basis for plant exploration."

"This was my first foreign travel since I became plant exploration officer," said Perdue. "While I have had substantial experience abroad, as a result of this new travel experience I was even better exposed to practical problems of exploration for germplasm. The new ideas which emerged will be reflected in the plant exploration manual I have been asked to prepare."

For further information, contact: Robert Perdue, Plant Exploration and Taxonomy, Office Bldg. 265, Beltsville, MD 20705, (301) 344-2431. ■

CSRS Research Confirms Potential For New Crops In Arid Lands

Scientists are increasingly optimistic about adapting new crops for arid lands production as a result of preliminary research established during the first five years of the Western Regional Project 157 (W-157), *Development of New and Alternative Crops for Water Conservation in Arid Lands.*

Supported through the Cooperative State Research Service (CSRS) of USDA, the project's five-year report indicates that although the relationship of water to yield will limit the development of some new crops, others will likely develop into new water conservation crops with commercial scale potential. Project findings include the following:

- Centered at the University of California-Davis, research is underway on ***Brassica*** species. While erucic acid-free and glycosinolate-free cultivars have not been released, major reductions in these undesirable compounds have been made. Several lines of ***Brassica*** **rapus** (common rapeseed) have been recommended for further testing. Rapeseed is the major oil crop in Canada and the second most important crop in that country. The United States is the chief importer of the oil.

- **Buffalo gourd** has been found to have sufficient cold tolerance for the Great Basin by personnel at the University of Nevada, Las Vegas, and the University of Arizona (U. of A.). Yields of proteins, oil and starches are now considerd high and should make the crop commercially feasible for most of the Southwestern United States and Mexico.

- The use of 25 USDA **guayule** lines in combination with new germplasm collections will soon lead to the release of new guayule cultivars by the University of California at Riverside and at Davis, and by the University of Arizona. Rubber percentages twice that of the standard check variety have been reported. Cold tolerance, water usage, herbicide reaction and salinity tolerance research is also underway.

- In preliminary yield trials at Montana State University, **amaranth** compared favorably with other small grains grown in the same area. Amaranth also appears to be well adapted to the dryland conditions of northeastern Colorado. Other new and alternative crops under study in W-157 are: jojoba, guar, intermediate wheatgrass, proso and pearl millet, kenaf, quinua, cuphea, Arizona cypress and Quetta pine.

For further information, contact: Duane Johnson, Chairman, W-157, Agronomy Dept., Colorado State University, Fort Collins, CO 80523, (303) 491-6438. ■

GENETIC ENGINEERING UPDATE

The last issue of DIVERSITY reported on a lawsuit filed in Washington in September 1983 challenging the environmental release of a microorganism genetically engineered to attempt to protect a potato crop from frost damage (see DIVERSITY, no. 5, p. 3). Since then there have been numerous developments concerning regulation of the genetic engineering (or biotechnology/ industry, as well as publication of major reports exploring its potential. Following are brief summaries of several of these recent developments: in future issues of DIVERSITY we will continue to explore implications of this new technology for the agricultural sector generally and the germplasm community in particular.

- First the lawsuit: the matter is currently in the discovery (pre-trial) phase, with the government preparing answers to questions posed by the plaintiffs. The actual **potato crop experiment, using genetic engineering techniques, remains suspended** as a result of adverse weather conditions and a decision last fall by the investigators not to press the issue at that time. Presiding over the legal proceedings is senior judge of the U.S. District Court in Washington, DC, John J. Sirica who presided at the Watergate trials.

- Last June two **House of Representatives subcommittees held a joint heating on environmental releases of genetically engineered organisms.** Both the hearing transcript and the subcommittee staff report were published in February. The report concludes, "The potential environmental risks associated with the deliberate release of [such] organisms or the translocation of any new organisms into an ecosystem are best described as [of] 'low probability, high consequence risk'; that is, while there is only a small probability that damage could occur, the damage that could occur is great."

  Among the staff's recommendations: creation of an interagency task force to review all proposals for deliberate release; extension of the Environmental Protection Agency's authority under the Toxic Substances Control Act to cover deliberately released organisms; permission for "research and commercialization to proceed with minimum interference while adequately addressing environmental and public health concerns"; and review by the Congressional General Accounting Office of USDA's biotechnology activities in order to evaluate the department's oversight authority. Follow-up discussions among the relevant players are reportedly underway. For copies of the report, write: The House of Representatives, Committee on Science and Technology, Publication Office: H2-108, 3rd and D Sts. NW, Washington, DC 20515.

- The **Congressional Office of Technology Assessment recently issued a massive analysis of the potential scope of the emerging biotechnology industry** in the U.S., four European countries and Japan. Among the findings: "Applications of rDNA technology to plant agriculture arc proceeding faster than anyone anticipated three to four years ago. Some important traits of plants, including stress-resistance, herbicide-resistance and pest-resistance, appear to be rather simple genetically, and it may be possible to transfer these traits to important crop species in the next few years. Other traits, such as increased growth rate, increased photosynthetic ability, and the stimulation of nitrogen fixation, are genetically complex, and it is likely to be several years before plants with these characteristics developed with rDNA technology will be ready for field testing. Microorganisms that interact with plants offer possibilities for genetic manipulation that may be more near term."

  As for U.S. bioscience in the international arena, OTA argues that the most important ingredients will be the availability of venture capital and tax incentives to start new firms, government funding of basic and applied research, and the availability of adequately trained scientific and technical personnel. For copies of the report, "Commercial Biotechnology and International Analysis" (#052-113-11939-1). write: U.S. Government Printing Office, Washington, DC 20402.

- A strong endorsement for the kinds of support outlined by OTA has come from **a new report on genetic engineering from the National Association of State Universities and Land Grant Colleges,** more specifically, from its Agriculture Division's Committee on Biotechnology. Issuing its second progress report last November, the committee reported that the State Agricultural Experiment Stations during 1983 had 283 scientist full-time equivalents working on 579 biotechnology projects funded at the level of $41.5 million. What we need now, the committee argued, is a $70 million research, fellowship, and equipment grant program emphasizing molecular biology, molecular and cellular genetics, and developmental biology, all aimed at using new biotechnological research findings to meet the needs for food and agriculture. For copies of the report, "Emerging Biotechnology in Agriculture: Issues and Policies,"Progress Report II, write: NASULGC, One DuPont Circle, Suite 710, Washington, DC 20036.

- **Genetic engineering has been the subject of ever increasing attention in the non-scientific mass media.** Among the recent pieces: a cover story in *Business Week* (January 13,1984), another in *Venture* (February 1984). and articles in *Discover* (December 1983) and *Atlantic Monthly* (January 1984). In the words of the *Venture* article on agricultural applications, "Recent breakthroughs in genetic engineering could move the Corn Belt north, triple the size of chicken eggs, and do away with fertilizers." These advances, the magazine points out, using information developed by the Milwaukee-based plant science consulting firm L. William Teweles and Co. "will result in a market worth $8 million worth of seeds in 1985 and $7 billion in the year 2000." ■

INTERNATIONAL PERSPECTIVE

Mexico and United States Launch Major Plant Genetic Resources Program

An unprecedented Memorandum of Understanding (MOU) for cooperation between the United States and Mexico in activities related to plant genetic resources was signed in late 1983 by U.S. Secretary of Agriculture John Block and the Mexican Secretary of Agriculture, Horacio Garcia Aguilar. The MOU was negotiated under the umbrella of a broader 12-year agreement for scientific and technical cooperation in the areas of agriculture and natural resources that was recently renegotiated between the two countries.

Under the comprehensive MOU, Mexico and the United States have agreed to cooperate in a joint program to gather, preserve, increase and distribute plant germplasm. The program is "aimed at the solution of common problems related to plant genetic resources [that] can lead to important mutual benefits and even increase the efficiency and effectiveness of the respective national crop protection and production plans carried out by each government."

The agreement assigns the following priorities to the initial joint activities to be carried out under the MOU: evaluation of germplasm; preservation of germplasm; specialization and exchange of scientific personnel: development and preservation of panmictic populations; experimental plant breeding; and increasing and updating data for plant genetic resources through information systems.

The MOU also assigns special priority for work on the following crops: corn, beans, chili peppers, wheat, sunflowers, cucurbitaceae, fruit trees, soybeans, potatoes and tomatoes.

One of the specific areas of concern the agreement refers to is the "serious shortage of personnel trained in the different biological aspectsof plant genetic resources" recognized by both countries. To address this problem, the MOU stipulates that study programs are to be developed utilizing Mexican and U.S. facilities and human resources.

First Target: Latin American Maize Resources

These and other priorities and strategic plans for carrying out the terms of the agreement are based on meetings held in 1979 between the U.S. National Plant Genetic Resources Board (NPGRB) and the Instituto Nacional de lnvestigaciones Agricolas (INIA) at Mexico City. In addition to the NPGRB's critical long-range planning and analysis efforts (without which, most observers agree, there would have been no agreement). other components of the National Plant Germplasm System made significant contributions in formalizing and implementing activities under the agreement.

The first activity initiated under the MOU - the increase, evaluation and preservation of Latin American maize- is a result of major planning efforts by the Maize Crop Advisory Committee, the NPGRB and the National Plant Germplasm Committee. Quentin Jones and Sheila Gillette, ARS; Wilfredo Salhuana, Pioneer Hi-Bred International, Inc., and Major Goodman, North Carolina State University, also played instrumental roles in developing the maize project. This project builds upon a cooperative program begun in 1940 by the Rockefeller Foundation, the U.S. National Academy of Sciences and the Mexican Ministry of Agriculture.

The U.S. Agricultural Research Service, which redirected 540,000 in 1982 to support planning for the Latin American maize project, recently negotiated a cooperative agreement with the North Carolina Agricultural Research Service. That agreement lays out a specific plan for rescuing, evaluating and preserving Latin American maize held in Colombia, Mexico and Peru.

The Office of International Cooperation and Development will coordinate the USDA involvement in the cooperative activities with Mexico. For further information. contact: Victor Muniec, OICD/USDA, Auditors Bldg., 14th St. and Independence Ave., SW, Washington, DC 20250, (202) 382-9841.

New Mooney Book Charges Third World "Gene Drain" By "North"; Intensifies International Controversy Over Genetic Resources

An alleged "gene drain" claimed to be siphoning off germplasm from Third World countries in the "gene rich" South to gene banks and breeding programs in the "grain rich" North is the subject of a new publication *(The Law of the Seed)* by Pat Roy Mooney. The recently published book is causing considerable controversy in the international plant genetic resources community (see stories p. 16 and p. 19).

Mooney, known for his work with the Brussels-based International Coalition for Development Action (ICDA) and his 1979 book, *Seeds of the Earth,* asserts that it is "almost impossible to exaggerate the North's dependence upon Third World germplasm." According to Mooney, the developing countries of the South have been "donating their genetic material in the belief that its botanical treasures form part of the 'Common Heritage' of all humanity." Meanwhile, he charges, "The North has been patenting the offshoots of this common heritage and is now marketing its new varieties, at great profit, around the world."

In addition to well-documented analyses on the genetic erosion threatening the Third World centers of genetic diversity, (and his assertion that existing international efforts are "inadequate" and "myopic in approach"), the new Mooney book focuses on how the South has become the "unwitting 'raw materials' supplier" for: (1) transnational enterprises owning seed and chemical companies that "use Third World germplasm to develop commercial seed which is sold back to developing countries at high prices"; and (2) thedeveloping high-tech genetic engineering industry ("the Genetic Supply Industry") in the North.

Based on his calculations that agricultural applications of biotechnology will value $100 million by the end of the century, Mooney argues that for both "political" and "practical" reasons this new technology should be based in the South.

Mooney Targets IBPGR and Proprietary Rights

Mooney concludes his lengthy study with detailed recommendations on how to counteract what he calls the "grab being made for the control of germplasm" by the North.

Two of these recommendations causing increasing concern among many genetic resourcesspecialists in the United States and other developed countriesare based on the proposed establishment of a legally binding International Convention to govern the exchange of plant genetic resources. These recommendations call for (1) the "restructuring" of the International Board for Plant Genetic Resources (IBPGR) under the control of the Food and Agriculture Organization and the Convention and (2) the inclusion of the full range of germplasm categories-from primitive cultivars to improved varieties and advanced breeding lines-within the Convention's proposed requirement for the "full and free exchange" of germplasm.

Influences FAO Debate

Mooney's book was prepared in time for him to distribute it at the 22nd FAO Conference last November in Rome (see story p. 16) and according to observers, many of his allegations served as the basis for much of the fierce debate between developing and developed countries. That debate ultimately resulted in a resolution to establish an international "undertaking" on plant genetic resources very similar to the convention Mooney calls for in *The Law of the Seed.*

The ICDA, publisher of *Seeds of the*

(Continued on next page)

FAO Calls For International "Undertaking" On Plant Genetic Resources

Differences that had been brewing for over a decade within the international community over how best to conserve and manage the world's plant genetic resources erupted when FAO members debated-and ultimately adopted-a resolution to launch an International Undertaking on Plant Genetic Resources.

The resolution (8/83), adopted November 23 at the 22nd Conference of the U.N. Food and Agriculture Organization (FAO) in Rome, declares that the Under taking is based on the "universally accepted principle that plant genetic resources are a heritage of mankind and consequently should beavailable without restriction."

The document defines plant genetic resources "to mean the reproductive or vegetative propagating material" of the following categories of plants: cultivated varieties (cultivars) in current use and newly developed varieties: obsolete cultivars; primitive cultivars (land races); wild and weed species, near relatives of cultivated varieties; and special genetic stocks (including elite and current breeders' lines and mutants).

"Strong Moral Implication"

The FAO describes the Undertaking as having "a strong moral implication rather than a legally binding character" due to the voluntary nature of the various committments it asks of governments to safeguard genetic resources and to ensure their "unrestricted availability for the purposes of plant breeding and agricultural development of all countries."

Governments are asked to take action to better explore and collect in their own territories all valuable plant genetic resources that are in danger of becoming extinct. They are also asked to maintain or to develop and adopt legislative measures to protect and preserve such resources in their natural habitat or, if necessary, in gene banks or living collections. Governments and institutions having placed such resources under their control should allow unrestricted access to samples of such resources by others for scientific and plant breeding purposes. according to the FAO resolution.

The Undertaking also calls for strengthening international efforts supported by FAO, other UN institutions and the Consultative Group on International Agricultural Research (CGIAR) including those of the International Board for Plant Genetic Resources (IBPGR), in "the scientific guidance and promotion of plant genetic resources collections, preservation and exchange.

An FAO spokesman added that the Undertaking particularly aims at strengthening capabilities of developing countries to survey and safeguard their own resources, to breed improved crop varieties and to develop their infrastructures in seed production and distribution.

FAO officials told reporters that "at the heart of the Undertaking is a commitment to develop under the auspices of FAO an internationally coordinated network of national, regional and international centers in order to hold, for the benefit of the international community and of future generations, collections of plant genetic resources of important plant species." This material, they continued to stress, "should be held on the principle of unrestricted exchange."

Commission Established To Monitor Undertaking

In another action, the FAO Council established a Commission on Plant Genetic Resources to monitor the arrangements set forth in the Undertaking.

According to the resolution (9/83), the responsibilities of the new commission include:

- recommending measures needed to make the global system more comprehensive.
- recommending measures to increase the efficiency of the global system's operations, and
- reviewing all matters relating to policy, programs and activities of the FAO in the field of plant genetics resources.

The Commission will be open to all FAO-member nations and will meet simultaneously with the FAO Committee on Agriculture (COAG).

Heated Debate Precedes Votes

Observers report that debate between developed and developing countries over the resolutions was at times "heated and acrimonious." Most contentious seemed to be the issues surrounding the Undertaking's potential effect on plant variety protection, financial support and the impact of the new commission that would be working outside the existing IBPGR/CGIAR system.

Some delegations argued that the new "intergovernmental" body could, in fact, reduce efficiency because of possible overlap with IBPGR activities and that its potential perception as a political body "could alienate many in the international scientific community." The following delegations "reserved their positions" on the Undertaking: Canada, France, Federal Republic of Germany, Japan, New Zealand, Switzerland, United Kingdom and the United States. The same delegations, with the exception of New Zealand and the addition of the Netherlands, "reserved their positions" on establishing the Commission.

U.S. Assessing Impact

It appears, based on interviews with both public and private sector representatives in the U.S. germplasm community, that the United States is continuing to assess the impact of the resolutions on U.S. policiesand the IBPGR system which it has strongly supported.

Some observers in the United States have voiced concern over how the U.S. position was handled and have questioned the delegation's decision for the U.S. to "reserve its position" in the voting. There also seemed to be some confusion and disagreement over how the delegation, headed by Secretary of Agriculture John Block and FAO Ambassador Millicent Fenwick, was briefed and which agency of those involved-the State Department, USDA Agricultural Research Service and Office of International Cooperation and Development-had the lead.

Some organizations outside of the government are alsoconcerned over the FAO resolutions and are taking action. An official at the American Seed Trade Association (ASTA) said ASTA has established a special committee to look into the possible ramifications of the Undertaking. That committee was meeting as DIVERSITY went to press.

For further information, write: FAO of the United Nations, Liaison Office for North America, 1001 22nd St., NW, Washington, DC 20437. ■

Mooney

(Continued from page 15)

Earth, announced that it will release another book on the "seeds" issue co-authored by Pat Mooney and Cary Fowler, National Sharecroppers Fund, in 1984. *The Law of the Seed* was published in *Development Dialogue* (1983:1-2). For further information and copies of the book, write: The Dag Hammarskjold Foundation, Ovre Slottsgatan 2, S-752 20 Uppsala, Sweden. ■

The *Viewpoints* section of this issue of DIVERSITY includes an article by Stephen Smith. Pioneer Hi-Bred International. Inc.. in which he responds to some of the points made by Pat Mooney in *The Law of the Seed.* The editors hope other readers will continue to use the *Viewpoints* forum to express their views on this and all issues concerning plant genetic resources. *-Ed.*

New Biography Honors Pioneer Plant Explorer Frank N. Meyer

A fascinating biography honoring Frank N. Meyer-the plant explorer whose pioneering expeditions to China and Central Asia at the turn of the century resulted in thousands of plant introductions to the U.S. Department of Agriculture - will soon be published by Iowa State University Press.

The book, *Frank N. Meyer: Plant Hunter in Asia**, brings to life Meyer's vow to "skim the earth in search of things good for man," which guided him through four perilous and heroic plant expeditions. Many see Meyer's efforts as having been instrumental in establishing the preeminence of American agriculture and his achievements continue to serve as an inspiration to plant explorers throughout the world.

This intriguing account, related by Isabel Shipley Cunningham, is an adventure story that combines carefully researched biography with agricultural history and botanical discovery. The story begins when the Dutch-born Meyer entered China in 1905 - during the dawn of an era when explorers could travel freely there-to become the first plant explorer to search primarily for economically useful plants. This three-year expedition included an 1800-mile journey on foot through the primeval forests of Korea and into Siberia.

"Herculean" Efforts Rewarded

Cunningham vividly describes the treacherousconditions and entertaining personalities Meyer encountered on an unprecedented odyssey which ended when the plant explorer mysteriously disappeared from a steamer on the Yangtze River. It was on this fourth and last expedition to Asia that Meyer succeeded in an "herculean" effort to collect one hundred pounds of blight resistant pear seeds.

Throughout even the most difficult of his journeys, Meyer managed to send the U.S. Department of Agriculture hundreds of shipments of live cuttings and thousands of sacks filled with seeds, a total of 2,500 plant introductions. The author says that some of these collections have resulted in drought-resistant shade trees, the hardy yellow rose, blight-resistant pears and chestnuts, and other food and fodder crops vital to modern American agriculture.

Perhaps most important of all, says Cunningham, is that plant breeders are still using the genes Meyer's introductions added to America's crop germplasm to produce better grains, fruits, vegetables and ornamentals.

The book is based primarily on 2,500 pages of letters from Meyer to colleagues at USDA and includes photographs and maps of Meyer's expeditions as well as appendices listing the plants he collected, the 1920-1982 winners of the Frank N. Meyer Memorial Medal for distinguished service in foreign plant introduction, and the Meyer germplasm available to plant breeders today. ■

Photo Courtesy of USDA
New Crops Research Branch

The above photo of Frank N. Meyer was taken on February 26, 1908, in Wu -Tai Shan, Shansi, China, *after* ***his*** *return from a successfulexploration trip* ***in the high mountains. Plant breeders today still use the genes Meyer's introductions added to America's crop germplasm.***

Isabel Cunningham, a graduate of Coucher and Smith Colleges, lives in Annapolis, Maryland, and writes and lectures on a variety of subjects including plant exploration. In a preface to the book, the author comments, *"For sixty years Meyer's contributions have remained a neglected segment of America's heritage. Now, as people are becoming concerned about the world's food supply and the loss of genetic diversity of crops, the time to tell his story has come. "*

In a recent review of the book, Frederick G. Meyer, supervisory botanist at the National Arboreturn, Washington, DC, praised Isabel Cunningham's work as *'splendid research, quite scholarly in every way and full of the kind of detail that will make it a classic of its kind . She has told the world for the first time a tale of high adventure that brought riches and fame to the United States and many other countries of the world Frank Meyer-perhaps the leading plant explorer among the many that have been sent out by the U.S. Department of Agriculture- is one of America's unsung heroes Mrs. Cunningham has done a great job. "*

***Frank N. Meyer: Plant Hunter in Asia,** Isabel S. Cunningham. Iowa State University Press, Ames, Iowa, 1984, 296 pp., $29.95. For further information, write: Iowa State University Press, 2121 S. State Ave., Ames, IA 50010.

U.S./Dutch Joint Urban Forestry Exchange Program Developed

United States and Dutch forest genetics experts have developed an urban tree cultivar and technical information exchange program that should benefit both countries. The collaborative effort is part of a formal urban forestry exchange program initiated in 1981 by the USDA Forest Service, the Office of International Cooperation and Development, and the Dutch Ministry of Agriculture.

To prepare for the joint program's exchange of tree cultivars selected for city environments and for the necessary performance testing and evaluations, the Forest Service asked Henry Gerhold, professor of forest genetics, Pennsylvania State University, and David Karnosky, director of the New York Botanical Garden (NYBG) Institute of Urban Horticulture, Cary Arboretum, Millbrook, New York, to meet with Dutch experts and make specific recommendations on how to implement the exchange.

The U.S. scientists visited commercial nurseries, arboreta, experimental plantations and various cities throughout the Netherlands during a 1982 fact-finding mission. They also met with representatives of the five Dutch organizations involved with tree cultivar selection and evaluation in the Netherlands.

Dutch Cultivars Recommended for U.S.

Gerhold and Karnasky compiled an initial list of more than 40 cultivars they recommended for importation into the United States. In addition, they made specific recommendations as to how U.S. cooperators could best organize to select, import, propagate, test, evaluate and distribute cultivars to producers and how they could most effectively exchange information. Their findings appeared recently in a paper published in *The Journal of Arboriculture* (December 1983). The paper was co-authored by Hans M. Heybroek, a tree breeder at the Netherlands' Institute for Forestry and Landscape Planning.

The authors observe that past urban tree cultivar introductions have been largely "opportunistic and disorganized, without thorough selection among or within species." They also note that much of the valuable knowledge about urban trees "exists only in the minds of various experts in both countries" and urge the establishment of a more systematic information exchange system.

Long-Term Investments Require "Wise Decisions"

The paper, "Urban Tree Cultivar Exchange Program of the Netherlands and the United States," details the steps necessary for the introduction of new tree cultivars into the planting practices of a country. The authors note that while the selection and distribution process needs to be further developed in both countries, the design of such procedures is "well advanced" in the Netherlands. The scientists caution that "wise decisions" regarding the entry of new trees into commercial production are of utmost importance because of the long-term large investments required to mass-produce and market new urban tree varieties before they can be expected to become profitable.

The next phase of the program to be expedited, according to the authors, is for the United States to import the selected trees for propagation. distribution and testing and to respond to reciprocal Dutch requests. They also recommend that agreement should be reached on the responsibilities that each of the participating agencies will have in the exchange program. These agencies include: the U.S. Forest Service, the American Association of Nurserymen, the USDA Agricultural Research Service, the USDA Plant Quarantine Office, and the Metropolitan Tree Improvement Alliance.

For further information and copies of the paper, write: Henry D. Gerhold, 306 Forest Resources Lab, Pennsylvania State University, University Park, PA 16802.

First Decade Contributions Of CGIAR Honored

A new book called **The Fragile Web: The International Agricultural Research System,** has been published to honor the first decade of work of the Consultative Group on International Agricultural Research (CGIAR), and to highlight the challenges of the next. The book, published in cooperation with the Canadian International Development Agency (CIDA), relates the history of the establishment of the CGIAR international agricultural centers and details the invaluable contributions these groups have made to developing countries.

The centersand their primary areas of concern are:

- CIAT: Centro Internacional de Agricultura Tropical (International Centre for Tropical Agriculture), Cali, Colombia, is concerned with the production of the food staples of the tropicsof the western hemisphere, particularly beans, cassava, rice, and beef.
- CIMMYT: Centro Internacional de Mejoramiento de Maiz y Trigo (International Maize and Wheat Improvement Centre), El Batan, Mexico, supports research around the world on maize and wheat as well as other major cereals such as barley and triticale.
- CIP: Centro Internacional de la Papa (International Potato Center), Lima, Peru, aims to improve the solanum potato and to develop varieties suitable for growing in many parts of the developing world, where it has great potential.
- IBPGR: International Board for Plant Genetic Resources, Rome, Italy, supports and promotesa network of international and national genetic resource centers to collect and preserve plant germplasm.
- ICARDA: International Center for Agricultural Research in the Dry Areas, Beirut, Lebanon, and Aleppo, Syria, concentrates on rainfed agriculture in semi-arid regions of North Africa and West Asia, with emphasis on durum wheat, barley, faba beans, and lentils.
- ICRISAT: International Crops Research Institute for the Semi-Arid Tropics, Hyderabad, India, is concerned with improving the quantity and reliability of food production in semi-arid regions of Africa, Asia, Latin America, and the Middle East, with emphasis on sorghum, pearl millet, groundnuts, chick-peas, and pigeon peas.
- IFPRI: International Food Policy Research Institute, Washington, DC, USA, focuses on the sensitive economic and political issues surrounding food production, food distribution, and the international food trade.
- IITA: International Institute of Tropical Agriculture, Ibadan, Nigeria, concentrates on lowland tropical agriculture worldwide, with emphasis on roots and tubers, cereals, and grain legumes, as well as the improvement of traditional farming systems.
- ILCA: International Livestock Centre for Africa, Addis Ababa, Ethiopia, carries out research and development on improved livestock production and marketing systems for tropical Africa.
- ILRAD: International Laboratory for Research on Animal Diseases, Nairobi, Kenya, seeks controls for two major livestock diseases, trypanosomiasis and theileriosis, that limit livestock production in huge areas of Africa, Asia, Latin America, and the Middle East,
- IRRI: International Rice Research Institute, Los Batios, Philippines, the first of the international centers, continues to work on the improvement of tropical rice and rice-based cropping systems and related technologies.
- ISNAR: International Service for National Agricultural Research, The Hague, Netherlands, the youngest of the centers, responds to requests from developing countries for assistance in strengthening their national agricultural research programs.
- WARDA: West Africa Rice Development Association, Monrovia, Liberia, aims to promote self-sufficiency in rice for a 15-country region where rice is a staple food and where there is great potential for increased production.

The booklet may be obtained from the International Agricultural Research Centre, Box 8500, Ottawa, Canada KIG 3119. ■

VIEWPOINTS

The Plant Breeder's Perspective On Genetic Diversity: A Reply To Pat Mooney's *The Law Of The Seed*

By Stephen Smith

Pat Mooney is correct to publicize the extreme importance of genetic diversity in the construction of a sustainable supply of new and improved crop varieties in his new book *The Law of the Seed.* (See story, p. 15). Plant breeders, whose task it is to piece together germplasm, realize, above all, the importance of genetic diversity for it is the raw material with which they work. We could all agree that "germplasm is the absolute underpinning of the global food system" and that germplasm conservation should not just figure prominently in political debate, but receive more real input of resources (see DIVERSITY no. 5, p. 8).

Unfortunately, Mooney proceeds to develop several lines of argument that do little to support a course of action that might realize this goal. His arguments lose credence since they are based upon inadequately researched and documented data. More significantly, *The Law of the Seed* reveals that Mooney misunderstands the nature of germplasm resources and has no conception of the contribution made by breeders in the construction and evaluation of germplasm. This review, because of its brevity, cannot touch specific points in detail: however, the following issues also addressed by Mooney will be covered: (1) the location of germplasm, (2) the role of the plant breeder, (3) the potential of exotic germplasm, and (4) a positive approach toward an equitable distribution of germplasm enhancement activities.

Location of Germplasm Resources: North and South

Most of the world's food supply rests upon crops with origins 5,000-10,000 years ago, or at least with centers of diversity in China, India, Indo-Malaya, central Asia, near East, Mediterranean area, Abyssinia, south Mexico/central America, South America, Chile, and Brazil-Paraguay (Zohary, 1970). Following initial domestication, genetically heterogenic crop varieties and associated weed complexes were carried by man from the then relatively "developed" southern countries to the relatively "undeveloped" northern countries. The germplasm reserves of "northern" countries thereby rest upon derivatives of land-races that were moved from original domestication sites more than 5,000 years ago. Increased agricultural productivity linked with developing socio-political systems allowed northern countries to broaden their industrial base and to develop at a fast rate, especially after the agricultural and industrial revolutions in the 18th and 19th centuries, respectively.

It is therefore incorrect to state that the "south" alone is gene rich. Considerable genetic diversity, tracing back thousands of years, exists in the "north." The tremendous advances made by slant breeders (Russell, 1974: Duvick: 1977) could not have been possible without this diversity. Furthermore, genetic diversity can be detected from morphological, cytogenetic, breeding and isozyme data. The "north" is therefore both grain *and* gene rich.

The Role of the Plant Breeder

Plant breeders not only enhance the performance of crop varieties, but they also increase the value of germplasm. A sample of genes only has practical use as germplasm when those genes are assembled into blocks that can function effectively in providing food resources. Thus, plant breeders both realize and create genetic worth by molding genes into agronomically functional germplasm. Hawkes (1983) describes eight sources of germplasm, five of these sources are present in "northern" countries. Furthermore, these sources provide the best adapted germplasm to agriculture. Plant breeding creates diversity and indeed often results in more complex diversity than can be seen in comparable groups of wild plants (Hawkes, 1983). Thus, the "north" is not only gene rich, it is *germplasm* rich.

The Potential of Exotic Germplasm

Despite the wealth of germplasm residing in the "north," it is difficult to conceive that all of the favorable genes are currently contained within these elite germplasm stocks. Exotic germplasm will most probably play its role in the medium-to long-term future of plant breeding by providing additional genetic diversity. Conservation of the sources of this diversity requires a minimum of two basic activities: collection within the geographical centers of diversity and maintenance of collections under controlled environments.

Unfortunately, a combination of circumstances has prevented many developing countries from conserving even their most familiar cultivars, weeds or wild species. Developing countries usually have more immediate, pressing problems that must be addressed. They also lack the technical and economic resources necessary to collect and maintain genetic resources.

Should genetic resources be then perhaps lost or should they be conserved! The answer is obvious. Collection, storage and dissemination of germplasm is thereby made through the various international centers under the coordination of the International Board for Plant Genetic Resources-in a system that guarantees collections will always be available to donor countries. Thus, the collection and maintenance efforts of developed nations have benefits for both the donor countries and society in general.

Further, it should be recognized that simply placing germplasm in cold storage is not enough. It can be highly subject to genetic erosion without adequate maintenance. Most important, germplasm is only useful once it is cataloged, evaluated, scientifically investigated and adequately maintained. For someone who expresses great concern about plant germplasm, Mooney exhibits a serious lack of knowledge of the routine activities carried out within a gene bank.

Although exotic germplasm provides a diverse array of genes, this diversity cannot be quickly molded or siphoned-off into agronomically well-adapted materials (Timothy, 1963; Hallauer, 1978). Exotic germplasm has genes arranged in linkage groups that can only be revealed, let alone utilized, after many cycles of recombination. Thus, although exotic germplasm is undeniably diverse and potentially useful, it requires a large investment of time and effort to render such diversity practically useful. Those of us who are committed to this goal find it ironic that we are criticized by Mooney for SIMULTANEOUSLY restricting the germplasm base while incorporating exotic genes into elite germplasm.

The "north" is not only grain rich, it is also germplasm rich and educationally advanced. The "south" is gene rich. but these genes are not so well arranged in linkage groups to provide an abundance of grain. Rather than attack every organization involved in the flow of germplasm and engender confrontation by cultivating an attitude of "north" versus "south," Mooney should attempt to foster a spirit of cooperation among those who have concerns about the combined fate of germplasm and the human race.

Progress to increase breeding and other germplasm-related activities within under-

(Continued on page 23)

The views expressed are not necessarily those of the editors. DIVERSITY welcomes the submission of articles by all interested parties in an effort to provide a forum for discussion of issues pertinent to the plant genetic resources community. The Editors

Stephen Smith is a research specialist engaged in the study of genetic diversity among exotic and cultivated germplasm of maize, soybean and wheat at Pioneer Hi-Bred International, Inc., Johnston, Iowa. Born and raised on a farm in Spalding, Lincolnshire, England, Smith gained a BS degree in plant sciences from Wye College (University of London), and a MS degree in the "Conservation and Utilization of Plant Genetic Resources" *and a PhD in the taxonomy and evolution of maize from the University of Birmingham, England. He joined the Pioneer staff after post-doctoral work studying isozyme diversity in maize and teosinte at North Carolina State University.*

Public/Private Responsibilities In Using Horticultural Genetic Resources

By Henry M. Munger

Plant scientists, among others, have long been concerned about the conservation of the genetic resources of the world. Great strides to this end have been made in recent years through the efforts of the U.S. National Plant Germplasm System, other national programs and the International Board for Plant Genetic Resources.

A more recent and increasing concern is the under-utilization of those genetic resources, for little is accomplished until valuable genes are recognized and put to use in varietiesgrown in fields and gardens. This concern is prompted in part by the reduction or demise of plant breeding programs in a number of the state agricultural experiment stationsand a substantial reduction in such programs in the U.S. Department of Agriculture.

The USDA Agricultural Research Service Program Plan for 1984-1990 (see DIVERSITY. no. 4, p. 4), dated February 1, 1983, calls for a decrease from $16.5 to $11.6 million for modifying germplasm of field crops and a decrease from $9.7 to $7.7 million for horticultural crops. Secretary of Agriculture John R. Block stated to the American Society of Agronomy in August I983 that "federal research is being phased out of conventional plant breeding programs where the private sector can meet the needs. That releases funding for basic research in plant genetics."

The key questions about Secretary Block's statement are:

- To what extent can the private sector meet the needs in transferring new genes from their original sources toacceptable varieties'!: and
- Will a shift in funds from plant breeding to basic research in plant genetics in fact remove more of the limitations to progress toward improved varieties'!

Impact of ARS "Phase Out" on Horticultural Breeding

Within the area of horticultural crops, the answers to these questions may differ for fruits and vegetables. There is essentially no private fruit breeding. For example, the production of small fruits, peaches, and increasingly of apples is based on publicly-bred varieties. The first disease resistant apples are beginning to come from the long-term efforts of several state experiment stations. In spite of the fact that fruits are the principal crop group for which patenting of varieties has been possible since passage of the Plant Patent Law in l930, this has clearly not provided the incentive for a significant amount of private fruit breeding. If there is going to be more breeding of disease resistant fruits, there is no escaping the fact that public plant breeders must do it.

Henry Munger is professor of Agriculture and Life Sciences, New York State College, Cornell University, Ithaca, NY. He raised some of the concerns discussed in this article at the last meeting of the National Plant Genetic Resources Board.

In regard to vegetable breeding, it is not as easy to define the extent to which the private sector can meet the required needs. If my comments appear to sound critical of the vegetable seed trade, let me say at the outset that this trade enterprise has my greatest admiration. In my visits to developing countries where farmers are trying to grow more vegetables, I frequently conclude that they don't need more research or extension at this point as much as they need a vegetable seed industry comparable to that of the United States.

In this country we have had a unique partnership between public plant breeders and vegetable seed companies that has resulted in getting better varieties onto farms. The seed companies have very effectively multiplied and distributed the varieties bred by public plant breeders as well as those from their own breeders. There has been good cooperation for many years between the two groups of breeders in exchanging both information and germplasm and I see it getting better all the time.

Public/Private Partnership Is Now Threatened

This partnership, however, is now being threatened by the dropping of applied breeding activities at one experiment station or university after another and by reduced support for these activities in the USDA. The vegetable seedsmen are becoming worried in part because they foresee a shortage of germplasm that has been developed to the stage where companies can afford to carry it on to produce finished varieties and because soon there may not be enough applied breeding programs to serve as vehicles for training a new generation of plant breeders.

This situation has arisen, in my opinion. in large part because seed company managers have oversold state and federal research administrators on the extent to which private breeders can carry the load of vegetable variety development. This, in turn, arises from different uses of the terms "basic" and "applied" in relation to research.

When seedsmen suggest that public agencies emphasize basic research and leave applied plant breeding to the private breeders, my experience indicates that administrators interpret this quite differently from what the seedsmen have in mind. For instance, if a scientist finds a gene for disease resistance in an otherwise worthless wild relative and determines its crossability and inheritance, an administrator can logically consider basic research to be finished. This may, however, represent only a small percentage of the time and effort required to breed a usable variety. Seedsmen, on the other hand, are more likely to think basic research isn't completed until the gene is actually incorporated into a population that, except for some variability in type, is close to commercial acceptability. This divergence in meaning leaves a gap which may explain why there are so many potentially valuable genes whose inheritance has been studied but which are not available in usable vegetable varieties.

Communication Is Vital Factor

Progress in using genetic resources would be facilitated if discussions between the public and private sectors would center on what specific problemsare to be solved and what each sector is able to contribute, rather than on generalities about basic and applied research that are subject to different interpretations. Although such discussions do go on between these two groups of research workers, there is a need for more communication between them and the managers and administrators. Unfortunately it is not unusual to find seed company managers making statements that discourage funding of the very same public plant breeding efforts that their own research staffs encourage.

Most vegetable breeders, public and private alike, deal with more than one crop and have limited support budgets. In the case of vegetables there is still a huge backlog of germplasm and of knowledge that has not been utilized because time and funds for breeding have had to be spread over so many crops. With more than enough work for everyone to do, there is no easy formula for dividing responsibilities between the twosectors. Open and continued communication is essential. It might be safe to generalize to the extent of saying that for the foreseeable future, public vegetable breeders will need to undertake applied breeding where long-term effort is required and the outcome is uncertain, particularly with the crops of lesser economic value.

Will public funds bring greater returns if shifted to "basic research in plant genetics" as suggested by Secretary Block?

The ARS Program Plan cited earlier refers to the need "to replenish the dwindling store of basic knowledge." My observations and experience provide evidence that most good plant breeding programs add to the store of basic knowledge rather than depleting it. Numerous examples could be given. Ruttan (1983) supports this concept when he says, "Instead of a single path running from scientific discovery through applied research to development, it is more representative to think of science-oriented and technology-oriented research as two parallel but interacting paths that both

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Cooperative U.S./Israeli Research Leads To Enhanced Oats, Barley, Wheat

By John G. Moseman

Two decades of cooperative germplasm research between Israeli and United States plant scientists have resulted in a valuable array of enhanced oats, barley and wheat germplasm for plant breeders.

The progenitors of oat, barley and wheat - *Avena sterilis, Hordeum spontaneum* and *Triticum dicoccoides*- respectively, grow wild throughout Israel. The fungal pathogens, which incite rust and powdery mildew diseases on those hosts, have coexisted with those hosts in certain sites in Israel for more than 5,000 years. The collaborative U.S./Israeli research has involved the collection, evaluation and use of the progenitor species todevelop enhanced oat, barley and wheat germplasm.

In addition to informal cooperation between individual scientists in both countries, this collaborative research has been funded through the following projects:

1. **PL-480-** funds obtained from the selling of United States surplus commodities to Israel. The money received from those commodities was used to support research in Israel which was beneficial to the U.S.

2. U.S./Israeli Binational Science Foundation (BSF) - funds obtained through contributions from both countries for particular projects conducted solely in Israel but which were beneficial to both countries.

3. Binational Agricultural Research and Development Fund (BARD)- funds from both countries for research projects conducted in both countries and which are mutually beneficial.

Some of the more significant results obtained from the above projects are discussed below.

Enhancement and Utilization Of Oat Germplasm

The oat research projects have primarily involved *A. sterilis* and a fungal pathogen, *Puccinia coronata.* This pathogen incites crown rust of oats. which was the most serious disease of oats in the United States. The host and the pathogen grow together throughout much of Israel. lssac Wahl, Director of the Germplasm Institute, Tel Aviv University, has been the principal investigator in Israel on most of the cooperative research projects. The late H. C. Murphy, USDA, Beltsville Agricultural Research Center (BARC), was the cooperating scientist in the United States from 1961, when the research was initiated, until 1968. Wahl has also cooperated with L. W. Briggle, USDA, BARC: M. D. Simons, USDA, Iowa State University, J, A. Browning, Texas A & M, and others. Results obtained from the collection and evaluation of *A. sterilis* include:

John G. Moseman, research plant pathologist in the Field Crops Laboratory, USDA/ARS, Beltsville, Maryland, conducts research on wheat and barley diseases and coordinates the USDA nursery programs on uniform leaf rust, international wheat rust and powdery mildew. Moseman, who has held various ARS leadership positions in barley research during his career with USDA, served as chairman of the Plant Genetics and Germplasm Institute from 1972 to 1981.

- Accessions of *A. sterilis* were identified which were high in percent and quality of protein. This finding was considered a scientific breakthrough since oats is a primary food source for humans and animals.
- Seeds have been collected from individual plants at many sites in Israel. Seed from 20,000 individual *A. sterilis* plants collected at 150 locations are maintained as accessions in the Leiberman Germplasm Bank for Cultivated Cereals at Tel Aviv University, and seeds from more than 5.000 individual plants are maintained as accessions in the USDA National Small Grain World Collection, BARC.
- Relationships have been determined between the presence of the crown rust pathogen and the percentage of *A. sterilis* plants resistant to that pathogen in Israel. Sites have been identified in which a high percentage of the plants are resistant to that pathogen.
- Accessions of *A. sterilis* have been evaluated and shown to be resistant to the crown rust pathogen in Israel.
- Evaluations of many *A. sterilis* accessions had been coordinated by H. C. Murphy for their reactions to the pathogens which incite crown rust, stem rust, and Barley Yellow Dwarf Virus, the three most prevalent oat diseases in the United States. Murphy identified accessions which are resistant to each of the three diseases.
- Briggle and Simons identified *A. sterilis* plants with a slow rusting type of resistance to the crown rust pathogen. Slow rusting should reduce the vulnerability of oat cultivars to new strains of that pathogen.
- Epidemiological studies conducted by Browning have shown that losses from severe epidemics of crown rust will be effectively reduced by resistance obtained from *A. sterilis* accessions in multiline populations.
- Research by K. J. Frey, Iowa State University, has shown that there are genes in *A. sterilis* accessions for increasing the yield of oat cultivars.

Many plant breeders are utilizing *A. sterilis* accessions to develop new oat cultivars with (1) resistance to crown and stem rust and Barley Yellow Dwarf Virus, and (2) with a high percent and better quality protein. The most effective crown rust resistance available today is derived from *A. sterilis.* Two new oat crown rust resistant cultivars have been developed and released in Texas. in addition to multilines in Iowa, and several crown rust resistant cultivars have been produced by Coker's Pedigreed Seed Company in South Carolina.

Enhancement and Utilization Of Barley Germplasm

U.S./Israeli barley research projects have primarily involved *H. spontaneum* and the fungal pathogens *Erysiphe graminis hordei,* and *Puccinia hordei,* which incite the diseases powdery mildew and leaf rust of barley, respectively. The host *H. spontaneum,* the pathogens *E. graminis hordei* and *P. hordei,* and the alternate hosts, *Liliacae* species, of *P. hordei grow* together in sites in Israel. Wahl has been principal investigator on many of the projects, and J. G. Moseman, USDA, BARC, has been the primary cooperating scientist on projects in the United States.

Results obtained from the collection and evaluation of *H. spontaneum* include:

- Seeds from 20,000 individual *H. spontaneum* plants have been collected at 100 sites in Israel, and are being maintained as accessions in the Leiberman Germplasm Bank for Cultivated Cereals. Seeds from more than 2,000 individual plants are being maintained asaccessions in the USDA National Small Grains World Collection at BARC.
- Coevolution of resistance in *H. spontaneum* and of pathogenicity in *E. graminis hordei* and *P. hordei* has been shown by (1) studying the evolution of rust species, (2) studying the roles of the alternate hosts in rust development, and (3) developing and using mobile nurseries.
- Types and effectiveness of resistance in *H. spontaneum* to powdery mildew and leaf rust pathogens have been determined and the effectiveness of slow rusting and mildewing in reducing disease development was demonstrated by special techniques. The number of genes in *H. spontaneum* effective in conditioning resistance to pathogens have been shown to depend on the pathogenicity and origin of the pathogen cultures.
- Many *H. spontaneum* accessions have been evaluated for resistance to pathogens which incite powdery mildew, leaf rust, scald, and net blotch of barley, which are the four diseases causing the greatest losses in barley production worldwide. Accessions have been identified which are resistant to each of the fourdiseases.
- Genetic diversity and variation in resistance to powdery mildew and leaf rust of *H. spontaneum* plants within and between sites in different ecological and geographical areas in Israel has been determined by E. Nevo, Haifa University, and D. Zohary, University of Jerusalem, and Moseman in a recently completed Binational Science Foundation (BSF) project.
- Research by D. Rodgers, Iowa State University, has shown that there are genes

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U.S. / Israeli Research
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in *H. spontaneum* for increasing the yield of barley cultivars.

Scientists in the United States and in many other countries are utilizing *H. spontaneum* accessions collected in Israel to develop improved barley cultivars. Facilitated recurrent selection composite cross populations of barley have been released in which the genes in *H. spontaneum* for resistance to leaf rust, powdery mildew and scald will be maintained and can be combined to increase their effectiveness against those three pathogens. R. T. Ramage, USDA, Arizona University, is using *H. spontaneum* accessions to develop facilitated recurrent selection composite cross populations with tolerance to high salt concentrations, increased water use efficiency, resistance todiseases and other useful characteristics.

Enhancement and Utilization Of Wheat Germplasm

Wheat research, initiated with the approval of a BARD project in October 1979 has involved *T. dicoccoides.* Dr. A. Blum at the Volcani Center is the principal investigator on the project in Israel. The cooperating scientists in the United States are E. L. Sharp, Montana State University, C. F. Konzak, Washington State University, and Moseman. Research results obtained through collection and evaluation of *T. dicoccoides* include:

- Seeds from more than 1,000 individual *T. dicoccoides* plants have been collected from individual plants at many sites in Israel which are being used and maintained at the Volcani Center. Seeds from more than 500 *T. dicoccoides* plants have been grown in quarantine and are now being maintained and used by the cooperating scientists in the United States. Seed from those plants are being maintained as accessions in the USDA National Small Grains World Collection at BARC.
- Scientists at the Volcani Center have identified *T. dicoccoides* plants which are (1) resistant to the pathogens *Puccinia striformis* and *Puccinia recondita* which incite the diseases stripe and leaf rust, respectively, and (2) other plants which are tolerant to drought or are high in protein.
- In the United States, Sharp has identified *T. dicoccoides* plants with minor and major genes for resistance to *P. striformis.* Konzak has determined protein and milling and baking qualities in many accessions. Moseman has identified accessions resistant to *Erysiphe graminis tritici* and *P. recondita* which incite the diseases powdery mildew and leaf rust, respectively.
- In a recently funded BARD project involving Nevo, Zohary, Blum and Moseman, the following has been accomplished: (1) more than 1,500 *T. dicoccoides* accessions have been collected at 37 sites: (2) the genetic diversity of *T. dicoccoides* accessions within and between sites has been determined; (3) sites have been identified in which a high percentage of the plants are resistant to powdery mildew and leaf rust: (4) accessions have been identified which are resistant to leaf, stripe and stem rust and to powdery mildew: and (5) accessions resistant to leaf and stripe rust and powdery mildew have been crossed onto cultivated durum and bread wheat to identify and to determine the number and relationship of the genes conferring resistance, and to transfer the resistance to cultivated wheat germplasm.

Progress is being made in the utilization of *T. dicoccoides* accessions to enhance wheat germplasm. In Israel, *T. dicoccoides* plants resistant to stripe rust and tolerant todrought have been crossed with durum and bread wheat varieties, and hexaploid bread wheat selections have been derived which are high in protein. In the United States, *T. dicoccoides* accessions resistant to stripe and leaf rust, and powdery mildew, and with good milling and baking quality, have been crossed with locally adapted wheat cultivars.

Present Status of Research

Wahl and Browning are continuing their cooperative research on the epidemiology of crown rust and the enhancement of oats germplasm. Many plant breeders are currently incorporating useful characteristics from *A. sterilis* into new oats cultivars - including this cultivar's high protein percent and quality and its resistance to crown and stem rust and to Barley Yellow Dwarf Virus.

A new BARD project has recently been funded in which Wahl, Moseman, and R. D. Wilcoxson, University of Minnesota, will study the mechanisms of resistance of *H. spontaneum* to leaf rust and will transfer resistance genes into barley cultivars. Enhanced barley germplasm will be obtained from the composite cross populations and from genetic stocks which have been and are being developed which have *H. spontaneum* accessions with resistance to many stresses as well as a number of other useful characteristics.

The enhancement of wheat germplasm will also be continued in the new BARD project. Nevo and Zohary will continue studyinggermplasm collection procedures, collect *T. dicoccoides* plants, and determine their genetic diversity and relationships to ecological, geographical and evolutionary factors, resistance to diseases and other characteristics.

BIum and the staff at Volcani Center will collect *T. dicoccoides* plants and evaluate them for (1) desirable morphological and physiological characteristics, (2) resistance to P. *striformis,* (3) tolerance to drought, and (4) higher protein quality and quantity and will then enhance wheat germplasm by transferring those useful characteristics into bread wheat germplasm. Moseman, at BARC, will introduce and grow the *T. dicoccoides* plants in quarantine, evaluate them for reactions to the pathogens *E. graminis tritici, P. recondita,* and possibly to other stresses, and then develop enhanced wheat germplasm by transferring the useful characteristics identified into durum and hexaploid wheat germplasm.

The information and enhanced oats, barley and wheat germplasm obtained through the cooperative U.S./Israeli research should reduce the vulnerability and increase and stabilize the productivity of those crops in the United States and worldwide. The research results illustrate the importance of collecting, evaluating and utilizing the progenitors of crop species where those crops originated and the need for close cooperation between scientists. The information obtained and the procedures used in this project should be applicable for developing enhanced germplasm of other crops.

Seed of the accessions discussed in this paper can be obtained by writing Dr. D. H. Smith, Jr.. Beltsville Agricultural Research Center, Bldg. 046, BARC-W, Beltsville, MD 20705, and to Dr. lssac Wahl, University of Tel Aviv, Tel Aviv, Israel. Copies of the final reports on the PL-480, BSF and BARD proiects are on file in the National Agricultural Research Library, Beltsville, MD 20705. ■

Horticultural Crops
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lead from, and feed back into, advances in scientific and technical knowledge." Plant breeding research is so productive because the breeder understands both the science and the technology needed, and is in a position to bring the two together. Shifting of funds away from public plant breeding will diminish the flow of new varieties, the acquisition of new knowledge that arises from this activity and the opportunities to train new plant breeders.

There are additional reasons for strong public vegetable breeding programs. One is to ensure that the needs of consumers, small farmers and gardners receive adequate attention because private breeders are likely to have little incentive to do research in this area.

Another is to help the developing countries where more vegetables are needed to improve the quality of diets. The United States has supported many programs to improve food production in these countries, and usually one of the first needs expressed is for better varieties, especially those with disease resistance.

The experience gained and germplasm available in active U.S. vegetable breeding programs can often be applied quickly in other countries. At the same time we can derive benefit from international cooperation by obtaining additional crop generations, more knowledge of the behavior of our plant genetic material under varied conditions, and more rigorous evaluation of resistance. ■

Reference

Ruttan, V. W. 1983. Agricultural Research Policy Issues. HortScience 18(6):809-818.

NEWS IN BRIEF

■ **Alva A. App has been named the new Director for Agricultural Sciences at the Rockefeller Foundation.** App was previously deputy director, International Center of Insect Physiology and Ecology in Nairobi, Kenya, where his responsibilities included direct supervision of a research and development program on crop production, livestock, and human health in Africa. He was also adjunct professor of soils, Agronomy Department, Cornell University.

From l964-1982 App, a graduate of Cornell University and Rutgers University, held positions at the Boyce Thompson Institute, Ithaca, New York, in the fields of plant and microbial biochemistry, physiology and pathology, Most recently he was director of the Boyce Thompson Program on Nitrogen and Crop Yields and leader of a research project on nitrogen fixation in rice at the International Rice Research Institute, Los Banos, Philippines. where he was a visiting scientist in the soil microbiology department. App's research and numerous scientific publications have been directed toward solutions to problems affecting food production in the developing world.

The Foundation's Agricultural Sciences Program is currently exploring possible new program initiatives. Genetic engineering of important food crops and its impact on developing countries is one such topic under consideration.

■ National Agricultural Library historian Alan Fusonie has prepared **a lecture on the entirely new range of economic plants introduced to Europe after the discovery of the New World.** The illustrated presentation focuses on the 400 years between the discovery of the New World and 1860 when European observers, travelers and dedicated naturalists explored the Americas gathering, classifying and labeling plant specimens. The lecture, which Fusonie is offering to present to interested groups, explores the flora collected and reflected in early botanical illustrated pre- 1860 publications and in early seed trade catalogs. The lecture includes rare botanical books. For further information contact: Alan Fusonie, National Agricultural Library, Beltsville, MD 20705, (301) *344-3876.*

■ **Barley germplasm evaluations at Aberdeen, Idaho, will he initiated in 1984 while continuing field evaluations of wheat and oat accessions begun in 1983 (see** DIVERSITY, no. 5, p. 7). Evaluation for disease and insect resistance, also begun in 1983, will be expanded as much as possible in 1984 and will include the following locations:

St. Paul, MN	Wheat &Oat Stem Rust
Manhatten, KS	Wheat Leaf Rust
Ames, IA	Oat Crown Rust
Urbana, IL	Oat Barley Yellow Dwarf Virus
Lafayette, IN	Wheat Hessian Fly
Corvallis, OR	Wheat Smuts .
Bozeman, MT	Barley &Wheat Growth Habit
Davis, CA	Wheat, Barley & Oat Barley Yellow Dwarf Virus

For further information, contact: L.W. Briggle, Research Agronomist, or D. H. Smith, Jr.. Curator, USDA/ARS, National Small Grains Collection, BARC-West, Beltsville, MD 20705, (301) 344-3713 or 3022.

■ R. 0. Hampton, USDA plant virologist, Oregon State University, was added to the **Pea Crop Advisory Committee** membership at the last CAC meeting. Hampton is an expert in pea viruses. In similar action, the **Phaseolus Crop Advisory Committee** membership was enlarged to include M. J. Silbernagel, USDA plant pathologist, Prosser, Washington, and G. P. Nabhan, research associate, College of Agriculture, University of Tucson, and president of the board of directors of Native Seeds/SEARCH (Southwestern Endangered Arid Land Resource Clearing House). In otheractions, A. R. Hallauer, Iowa State University, and R. L. Clark, NC-7 Regional Plant Introduction Station, have been added to the membership of the **Maize Crop Advisory Committee.** Clark, an *ex-officio* member, replaces Willis Skrdla who recently retired.

■ **Charles F. Murphy, ARS, Beltsville, Maryland, has been appointed executive secretary of the National Plant Genetic Resources Board (NPGRB).** The Board advises the Secretary of Agriculture on policy issues relating to the National Plant Germplasm System. The appointment, announced by Orville Bentley, USDA Assistant Secretary for Science and Education. became effective in December 1983. Murphy succeeds the late Clarence Grogan who had served as executive secretary of the Board since 1979.

While on assignment from North Carolina State University to the USDA/SEA program planning staff in 1981, Murphy served as chairman of the Germplasm Task Force which formulated the Long Range Plan for the National Plant Germplasm System (see DIVERSITY, no. 1, p. 6). In August 1983 Murphy joined the USDA/ARS National Program Staff as National Program Leader for Grain Crops.

■ **The offices and laboratories of the Regional Plant Introduction Station (NC-7) in Ames, Iowa have been moved** to the headquarters building at the station's farm while construction of a new agronomy building is underway on the Iowa State University campus. Telephone numbers and mailing addresses have not changed.

■ Four **new soybean seed varieties**-one Group VII variety and three Group V varieties-have **been announced by Jacob Hartz Seed Company, Inc.,** Stuttgart, Ark. All four of the new introductions are **disease resistant,** and are resistant to Race 3 cyst nematode, reniform nematode and bacterial pustule. The Group VII variety is **Hartz 7126.** The Group V varieties are: **Hartz 5171; Hartz** 5242, which is also resistant to phytophthora root rot; and **Hartz 5370,** also resistant to phytophthora root rot and which has moderate resistance to the root-knot nematode *Meliodogyne incognita.* For further information, contact: Jim Craig, Product Manager, Jacob Hartz Seed Company, Inc., P.O. Box 946, Stuttgart, AR 72160.

A Reply To Pat Mooney

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developed countries could help provide these areas with diverse, yet well-adapted, germplasm. These efforts could not only enhance germplasm diversity and agricultural productivity, but also provide a greater sense of self-esteem to freshly-developing countries. The idea, however, that individual farmers could themselves conserve and breed germplasm within a social structure remotely akin to present day "developed" societies is untenable in the light of historical developments.

REFERENCES

1. *Duvick, D.N. (1977). Genetic rates of gain in hybrid maize yields during the past 40 years. Maydica 22: 187-196.*
2. *Hallauer, A.R. (1978). Potential of exotic germplasm for maize improvement. pp. 229-247. IN. Walden, D.B. (ed.) Maize Breeding and Genetics. John Wiley 794 pp.*
3. *Hawkes, J.G. (1983). The Diversity of Crop Plants. Harvard Univ. Press. 184 PP.*
4. *Russell, W.A. 11974). Comparative performance for maize hybrids representing different areas of maize breeding. 29th Annual Corn and Sorghum Res. Conf. 29: 81-101.*
5. *Timothy, D.H. (1963). Genetic diversity, heterosis, and the use of exotic stocks in maize in Colombia. pp. 581-593 IN. Hamon, W.E. and Robinson, H.F.. editors. Statistical Genetics and Plant Breeding. Publ. 982. Natl. Acad. Sci-Natl. Res. Council, Washington, DC.*
6. *Zohary, D. (1970). Centres of diversity and centres of origin. pp. 33-42 IN. Frankel, O.H. and Bennett, E., editors, Genetic Resources in Plants-their exploration and conservation. Blackwell Scientific, 554 pp.*

Recent germplasm registrations announced in Crop Science (vol. 20, no. 6, *pp.* 1224-1228) include: **KS167 alfalfa germplasm,** developed by the Kansas Agricultural Experiment Station and USDA/ARS available from the Department of Agronomy, Kansas State University, Manhattan, **KS 66506: leaf rust resistant barley Composite Cross XL1 germplasm,** developed by the Montana Agricultural Experiment Station, available from the Curator, National Small Grains Collection, USDA/ARS, BARC, Beltsville, MD 20705; **powdery mildew resistant barley Composite Cross XLII germplasm** developed by the Montana Agricultural Experiment Station and USDA/ARS, also available from the Curator, National Small Grains Collection; **scald and net blotch resistant barley Composite Cross XLIII germplasm** developed by the Montana Agricultural Experiment Station, also available from the Curator, National Small Grains Collection; **diploid and derived tetraploid red clover germplasm,** developed by the Kentucky Agricultural Experiment Station, available from the Department of Agronomy, Agricultural Sciences Bldg.-N, University of Kentucky, Lexington, KY 40546-0091; **UArk-1 and UArk-2 - two early-maturing cotton germplasms** developed by the University of Arkansas Agricultural Experiment Station, available from C. Wayne Smith, P.O. Box 789, Cotton Branch Experiment Station, Marianna, AR 72360: **NDSAB** and **NDSF maize germplasm** developed by North Dakota State University Agricultural Experiment Station, available from H. Z. Cross, Agronomy Dept., North Dakota State University, Fargo, ND 58105; **wheat germplasm PI 466704 (GP222)** and **PI 466705 (GP 223)** developed by USDA/ARS and Washington State Agricultural Research Center, available from the Wheat Breeding and Production Unit, USDA/ARS, Pullman WA 99164.

For further information, write: *Crop Science*, 677 S. Segoe Rd.. Madison, WI 53711.

Recent cultivar and germplasm releases announced in *HortScience* (vol. 18, no. 6. pp. 96 (1966) include: **'Regal' elm,** developed by E.B. Smalley and D.T. Lester. University of Wisconsin, Madison, WI 53706; **'William Baffin' rose,** developed by Felicitas Svejda, Agriculture Canada, Ottawa Research Station, Ottawa, Ont., Canada KlA OC6; **'Reliance' seedless grape,** developed by J.N. Moore, Department of Horticulture and Forestry, University of Arkansas, Fayetteville, AR 72701; **Sugary (su) sweet corn germplasm with resistance to the maize dwarf mosaic virus,** developed by M.A. Mikel, Cleora J. D'Arcy, A.M. Rhodes, E.E. Carey and J.A. Juvik, University of Illinois, 1103 W. Dorner Dr., Urbana, IL 61801; **six Illinois Sweet Corn inbreds with the sugary enhancer (se) gene,** developed by J.A. Juvik, M.A. Mikel, E.E. Carey, and A.M. Rhodes, Department of Horticulture, University of Illinois, 1103 W. Dorner Dr.. Urbana, IL 61801.

For further information, write: ***HortScience*** American Society for Horticultural Sciences, 701 N. Saint Asaph St.. Alexandria, VA 22314.

Ray O. Hammons, a geneticist with the USDA Agricultural Research Service, Tifton, Georgia, **received the USDA Certificate of Merit for exceptional individual accomplishments and international leadership in peanut research and germplasm enhancement.** In addition, Hammons was awarded USDA's 1983 Eagle Award for exemplary service to agricultural research. This award singles out one scientist annually for special recognition in USDA's Southeast Area. Hammons is leader of the federal/state peanut breeding investigations at the Georgia Coastal Plain Station in Tifton.

J. Patrick Jordan, Administrator, Cooperative State Research Service (CSRS), USDA, appointed Daniel R. Tompkins as the CSRS representative to the National Plant Germplasm Committee. Tompkins will fill the CSRS position left vacant by the late Clarence O. Grogan. Tompkins, a horticulture scientist. has participated in the effort to establish the U.S. national clonal germplasm repository system.

ARS-supported plant exploration trips approved by the Plant Germplasm Operations Committee for FY 84 include: ***cicer milkvetch*** and other species of ***astragalus*** in Romania by C. E. Townsend, Fort Collins, CO: strawberries in the Pacific Northwest United States by C. H. Shanks, Jr., Vancouver, WA: and T. M. Sjulin, Puyallup, WA: cotton in Mexico by P. A. Fryxell and A. E. Percival, College Station, TX: various native woody landscaping species in the U.S. by H. M. Pellett, Chanhassen, MN; potato in Mexico by R. W. Ross, Sturgeon Bay, WI: hazel nuts in the U.S. Pacific Northwest by C. L. Johannessen and D. Brenner. Eugene, OR: and beans in Mexico by V. Marcarian, R. Buhrow, and G. P. Nabhan, Tucson, AZ.

Charles E. Geise recently retired as director of agricultural research for the Del Monte Corporation, San Leandro, California. Geise, who has been an active participant in National Plant Germplasm System activities throughout his career, currently serves on the National Plant Genetic Resources Board and was a member of the Germplasm Resources Information Project (GRIP) Coordinating Committee. William Hagan has been appointed as the new agricultural research director for Del Monte.

The Potato Crop Advisory Committee met in March to select 1984 germplasm evaluation locations for continuing work begun in 1983 on resistance screening to potato leaf roll virus, Colorado potato beetle, and *Verticillium* wilt. The group also discussed potential new screening work for foliar curly blight, *Erwinia* complex and root knot nematode. For further information contact: R. E. Hanneman, Jr.. University of Wisconsin, Madison, WI 53706, (608) 262-1399.

Thirteen public and private groups have volunteered to assist the Sugarbeet Crop Advisory Committee in seed increase of *Beta* germplasm. James Fischer of the American Society of Sugarbeet Technologists, working with NC-7 Regional Plant Introduction Station (RPIS) staff in Ames, Iowa, will coordinate thisactivity. Significant progress was also reported on identifying germplasm collections to be deposited at the National Seed Storage Laboratory as well as collections to be considered for inclusion in the NC-7 RPIS collections.

Collection of subtropical and tropical genera such as **Stylosanthes, Zornia, Neonotonia, Alysicarpus** and ***Rhynchosia*** will be emphasized this year at the Plant Genetic resource Centre/Ethiopia (PGRC/E). Addis Ababa. With support from the International Board for 'Plant Genetic Resources (IBPGR). PGRC/E will also make some collections of grasses *(Cenchrus, Brachiaria, Panicum)* and highland *Trifolium* species. In addition, the PGRC/E and the Asmara Regional Agricultural Office have signed a cooperative agreement resulting in the collection of 200 cereal and legume accessions and the multiplication and evaluation of wheat accessions at the Pardiso (Mekane Genet) Agricultural Research Station.

A technique long used to identify proteins for human medical research has been adapted to measure and monitor genetic variability among individual seeds within a *Phaseolus* population at the National Seed Storage Laboratory.

Maintenance of genetic diversity in bean germplasm collections has been inhibited by the lack of information on exact kinds of variation present within and among *Phaseolus* accessions in storage. Electrophoretic techniques now have been utilized to analyze seed storage proteins and isoenzymes in seed embryos. Results indicate that enzyme content is related to cotyledon storage protein type and that variability between and within sublines can be detected. Researchers are hopeful techniques such as electrophoresis will complement conventional evaluation activities and accelerate germplasm characterization while ensuring the preservation of genetic variability. For further information, contact: E. Roos, NSSL, Fort Collins, CO 80523, (303) 484-0402.

■ **M. P. Widrlechner has joined the NC-7 Regional Plant Introduction Station (RPIS) Ames, Iowa, filling the horticulturist position** left vacant since 1982. With the addition of Widrlechner to the staff, a regional program evaluating woody ornamental plants for adaptation to the North Central states has been reactiviated.

■ **E. D. Donnelly, Alabama State Agricultural Experiment Station (SAES), Auburn University, recently retired after a 35-year slant breeding career.** Donnelly is credited with breeding a dozen superior crop varieties released by the Alabama SAES. Donnelly has been recognized for his work to improve *Lespedeza sericea,* a poor-land hay and pasture crop that was, according to an Alabama SAES spokesman, generally written off as useless because of its poor forage quality. Donnelly's breeding research efforts produced release of five *L. sericeas,* beginning with Serala in 1962 and continuing to AU-Lotan in 1983, with each succeeding variety having superior characteristics to preceeding ones.

■ **The Agricultural Research Service reports that a new carrot hybrid, called A Plus, will be ready for commercial production and home gardening this spring.** Scientists at the Florida, California and Idaho Agricultural Experiment Stations worked with ARS to develop the new hybrid. The researcherssay the new variety provides better flavor and more nutrition and is a breeding advance over Orlando Gold, the carrot hybrid that was developed two years ago. ARS horticulturist Clinton Peterson said A Plus carrots contain 76 percent more vitamin A-producing carotene than the most widely grown variety now produced in California, 20 percent more than Orlando Gold. According to a carrot-growing industry spokesman, the development of Orlando Gold was of sufficient value "to pay for all previous research that has gone into carrot breeding." Peterson said consumer acceptance of A Plus carrots will be tested through commercial trials this year. For further information. contact: Clinton Peterson, USDA/ARS, Dept. of Agronomy/Horticulture, University of Wisconsin, Madison, WI 53706, (608) 262-1830,

Correction

A comment regarding U.S. germplasm exchange with China in DIVERSITY no. 5, p. 18, was meant to refer to another article in the same issue (p. 10). That article detailed a recent USDA-sponsored forage collection trip to China and pointed out that the collection trip represented "a significant step toward facilitating free exchange of germplasm between the two countries."

■ An ongoing **review of the world's genetic resources of temperate fruit and nut crops by the Northwest Plant Germplasm Repository at** Corvallis. Oregon has grown beyond the original objective of assessing the potential genetic vulnerability of each crop. Curator Otto Jahn says the review will now include evaluations of current problems, available resources and methods that can be used to develop genetic solutions. Team leaders are being selected for review on *Pyrus, Fragaria, Rubus, Ribes, Corylus, Vaccinium, Malus, Prunus, Juglans, Vitis, Carya, Castanea and Diospyros.* Project directors are also trying to locate authors for other minor crops and have requested suggestions or volunters to review *Actinidia, Sambucus, Pistacia, Morus* and other genera for which information is available and interest in production has been expressed. (The International Board for Plant Genetic Resources is developing a similar review for tropical and subtropical fruit and nut crops.) For further information, contact Otto L. Jahn, Curator, Northwest Plant Germplasm Repository, 33447 Peoria Rd.. Corvallis, OR 97333.

■ **Bruce J. Parliman** a research horticulturist with the Agricultural Research Service in Glenn Dale, Maryland, **has been awarded the $2,000 American Association of Nurserymen (AAN) Centennial Grant by the HRI Endowment Fund in support of his research into the propagation of hard-to-root woody plants.** Parliman said the objective of his project "is to determine the feasibility and conditions needed for rooting 'hard to propagate' Prunus and other woody plants from dormant scionwood."

The AAN Centennial Research Grant is made possible through interest earned on funds contributed to create a memorial to the 100th Anniversary of the AAN. The grant is one of several awarded through the Horticultural Research Institute Endowment Fund.

The non-profit HRI Endowment Fund was established by the Horticultural Research Institute to allow individuals, corporations and foundations to make tax-deductible contributions for the support of environmental horticulture research. For further information and grant applications contact: HRI Endowment Fund, 1250 I Street, NW, Suite 500, Washington, DC 20005, (202) 789-2900.

■ The **Horticultural Research Institute** (HRI) **will award $33,500 in Richard P. White and HRI Endowment Fund Research Grants in 1984. Any** organization conducting environmental horticulture research which will directly benefit the nursery business trade-such as state and federal agricultural research laboratories, universities, forestry research stations, business firms, botanical gardens and arboreta-are invited to apply. Funds may be used for any purpose- to initiate research to support ongoing projects, travel, etc. HRI's only requirements are the submission of an annual progress report and that the results of the research be given to the institute journal editor for peer review and possible publication in the HRI *Journal of Environmental Horticulture.* **Application deadline is May 1, 1984.** Grants will be awarded in November. Contact HRI, 1250 I St., NW, Suite 500, Washington, DC 20005, (202) 789-2900.

■ **The Plant Breeding Institute,** Cambridge, England, **has announced a project** to be funded for three years by the Rockefeller Foundation **which will explore whether viral genes introduced into plant chromosomes can induce resistance to subsequent viral infection.** Plant viral genes will be cloned in bacterial plasmids and transferred into the nuclear genome of plants using *Agrobacterium tumefaciens Ti* plasmid vectors. For further information, write: Plant Breeding Institute, Maris Lane, Trumpington, Cambridge, CB2 2LQ, England.

■ **More than 250 growers, food processors and members of allied industries attended the annual New York State Processing Vegetable Conference held recently at Canandaigua, New York.** Conference sessions were held on snap beans, beets, sweet corn and cabbage. The snap bean session included discussions on varietal screening and breeding for white mold resistance, root rot control, cold and heat tolerance, and techiques used to grow beans in Wisconsin. The beet session emphasized fertilization practices to achieve maximum yields, and controlling root rot. Discussions of weed problems and insect damage were covered at the sweet corn session. The cabbage session covered control of insect problems and discussed promising varieties growers might consider planting. For further information, contact: New York State Agricultural Experiment Station, Geneva, NY 14456, (315) 787-2252.

■ **An intensive course in seed pathology will be offered July 12-20 at Western Washington Research and Extension Center of Washington State University.** Puyallup, Washington. The course will cover both theory and practice and is designed for individuals who are responsible for all areas of seed-borne disease problems. Held in conjunction with and following a workshop of the Plant Disease Committee of the International Seed Testing Association, the course will offer participants the opportunity to meet an international group of scientists in seed pathology and to observe the results of their ongoing research in developing new and improved tests to detect seed-borne pathogens. For further information, contact: Richard L. Gabrielson, Western Washington Research and Extension Center, Washington State University, Puyallup, WA 98371, (206) 593-8530. ■

PUBLICATIONS

Common Diseases of Small Grain Cereals: A Guide to Identification, F. J. Zillinsky. International Maize and Wheat Improvement Centre (CIMMYT), 150 pp., 350 color photos, 918.75. (plus $2.50 postage). Thisguidebook is intended for the nonpathologist and provides information for identification of more than 70 diseases affecting bread wheat, durum wheat, barley, oats, rye and triticale: information about injuries caused by parasites and pests and physiological and environmental abnormalities; and practical tips for collecting, preserving and preparing disease samples. For further information, contact: Agribookstore, IADS Operations, Suite 600, 1611 N. Kent St., Arlington, VA 22209. For individuals and institutions in developing countries this publication is available for $10 plus $2 for handling and shipping and should be ordered directly from: CIMMYT, Londres 40, Apdo. Postal 6-641, Col. Juarez Deleg. Cuauhtemoc, 06600 Mexico, D.F.

Corn and Corn Improvement, ASA Monograph 18, George F. Sprague, ed. American Society of Agronomy, 1977, 774 pp., $20. This second edition is a complete revision of its 1955 predecessor. The up-to-date monograph investigates ideas relative to the origin of corn, examines the race concept of germplasm classification, and describes the major races. It maps the development of the hybrid seed industry with its new methods for the production, processing and distribution of hybrid seed. To obtain further information, write: Book Order Department, American Society of Agronomy, 677 S. Segoe Rd., Madison, WI 53711.

Frank N. Meyer: Plant Hunter in Asia, Isabel S. Cunningham. Iowa State University Press, Ames, Iowa, 1984,296 pp., $29.95. (See story, p. 17.) For further information, write: Iowa State University Press, 2121 S. State Ave., Ames, Iowa 50010.

Genetic Engineering of Plants: Agricultural Research Opportunities and Policy Concerns, Leslie Roberts. National Academy Press, Washington, DC, 1984, 96 pp., $9.50. The book is a summarization of a convocation sponsored by the Board on Agriculture of the National Research Council and The Council for Research Planning in Biological Sciences. Described as "an ideal introduction to the technology that promises to transform the agricultural enterprise," the book summarizes the recent convocation of government, industry and university experts and explores how gene cloning, gene transfer, and other techniques might be used to solve agricultural problems throughout the world. It begins with a primer on recombinant DNA technology and its development since the 1950s and explains how the tools of biotechnology can be applied to the plant sciences and agriculture. The book also takes a close look at how the commercialization of genetic engineering has created new ties-and new tensions-between industry and the university. For further information, write: National Academy Press, 2101 Constitution Ave., NW, Washington, DC 20418.

Genetic Evaluation and Utilization of Rice. International Rice Research Institute, $32.50 plus postage (515 air mail: 51.80 surface mail). This book covers cell and tissue culture techniques for cereal crop improvement. Available from International Rice Research Institute, P.O. Box 933, Manila, Philipines. Prepayment of orders in U.S. dollars, bank "demand draft" or with UNESCO coupons is required.

The International Biotechnology Directory 1984, J. Coombs. The Nature Press. New York, 1983, 400 pp., 5100. This directory covers both the traditional and the newly-emerging genetic engineering technologies and provides a buyer's guide to products, research and services. The directory includesmore than 2,000 organizations (companies, universities, and research centers) and government agencies and programs listed by country, product listings under more than 1,000 headings, and an alphabetical listing of databases, journals and newsletters. For further information, write: The Nature Press. 4 Division of Grove's Dictionaries, 16 East 26th St.. New York, NY 10010.

1983 Rice Germplasm Conservation Workshop. International Rice Research Institute 109 pp.. 96.25 plus airmail (U.S. $14.50) or surface mail (U.S. 51.75). (IRRI), 1983, The booklet summarizes the discussions and planning sessions of the second Rice Germplasm Conservation Workshop at IRRI in April of 1983. The workshop, jointly sponsored by IRRI and the International Board for Plant Genetic Resources (IBPGR), focused on revitalizing the collection activities toward completion of the conservation of diverse rice germplasm. For copies and further information write: Communication and Publications Dept., IRRI, P.O. Box 933, Manila, Philippines. (Note: The IRRI offers a 60% discount to individuals or organizations that represent developing nations.)

Tissue Culture of Trees, John H. Dodds, ed. AVI Publishing Company, Westport, 180 pp., $29.50. This book covers the use and development of new technologies to improve the quality and quantity of trees worldwide. It specifically addresses the culture of woody plants, dealing with the *in vitro* growth of most tree groups- hardwoods, softwoods, palms, ornamentals and fruits. Illustrated with charts and photographs, the book includes author and subject indexesand a comprehensive reference list. It is an information source for workers in plant tissue culture, pomology, forestry and horticulture. For further information, write: AVI Publishing Company, P.O. Box 831, Westport, CT 06881. Also available in Europe, Australia, and New Zealand from: Croom Helm Ltd., 2-10 St. John's Rd., London, SW11, England.

Vegetables in the Tropics, H. D. Tindall. AVI Publishing Company, Westport, 533 pp., 537.50. The book contains concise information on the cultural and environmental requirements of 140 vegetable crops grown in tropical regions. Information for each vegetable crop includes: climatic and soil requirements, propagation and establishment, crop density, soil fertility, irrigation, and reference to any special treatments such as staking or pruning. Crop details are given under family headings since many crops of the same plant family frequently have similar cultural requirements. The book is intended to serve as a textbook and as a reference for extension service staff and researchers who work with tropical crops. For further information, write: AVI Publishing Company, P.O. Box 831, Westport, CT 06881. Alsoavailable internationally from: Macmillan Press. Ltd.. Houndsmills, Basingstoke, Hampshire, England RG21 2XS.

World Vegetables: Principles, Production and Nutritive Values, Mas Yamaguchi. AVI Publishing Company, Westport, 377 pp.. 535. A three-part reference book organized to function as a textbook, the first two parts cover vegetables as food crops and a summary of vegetable physiology. These include classifications. nutrients, toxicants, and environmental factors affecting growth, as well as world food implications and nutrition. The third, and major, portion of the book includes information on more than 120 species of vegetables, covered in detail under such headings as origin, botany, culture, nutritive values, harvesting and storage, and also covers the broader categories of starch roots, tubers and fruits, and succulent roots, bulbs, tops and fruits. For further information, write: AVI Publishing, P.O. Box 831, Westport, CT 06881.

PERIODICALS

The Seedhead News is a new quarterly newsletter published by Native Seeds/ SEARCH (Southwestern Endangered Arid-Land Resource Clearing House). The publication is available to associate members of SEARCH, which is dedicated to the conservation of native crops and their wild relatives in the American Southwest. Associate membership is $10, and includes the newsletter, seed listings and catalogs, and a 10% discount on seed purchases, workshops and publications. For further information, write: Native Seeds/SEARCH, 3950 W. New York Dr.. Tucson, AZ 85745.

GeneWATCH is a new bimonthly publication by the Committee for Responsible Genetics (see DIVERSITY, no. 5. p. 20) covering public interest issues relating to emerging genetic technologies. For subscription information, write: Committee For Responsible Genetics, 5 Doane St., 4th Flr., Boston, MA 02109. ■

MEETINGS

April 9-l4 - **Conference on Provenance and Genetic Improvement Strategies in Tropical Forest Trees.** Mutare, Zimbabwe. Contact: R. D. Barnes, Commonwealth Foresty Inst.. South Parks Rd., Oxford OX13RB, England.

April 15-21 - **Plant Stress, UCLA Symposia on Molecular and Cellular Biology,** Keystone, Colo. Contact: UCLA Symposia, 103 MBI, University of California, Los Angeles, CA 90025.

April 17-19 - **International Symposium on Analytical Methods and Problems in Biotechnology.** Noordwijkerhout. The Netherlands. Contact: W. A. Scheffers, Delft Technological University, Microbiology Lab.. Julianalaan 67A, NL 2628 BC Delft, The Netherlands.

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, lnternational Rice Research Institute, P.O. Box 933, Manila, Philippines.

May 8- **36th International Symposium on Crop Protection,** sponsored by the Faculty of Agricultural Sciences, State University, Gent, Belgium. Contact: Secretary, Faculty of Agricultural Sciences, State University, Gent, Belgium. Contact: Secretary, Faculty of Agricultural Sciences, State University, Curpre links 653, B-9000 Gent, Belgium.

May 9-11 - **International Symposium on the Conservation of Genetic Resources of Aromatic and Medicinal Plants,** National Agricultural Research Station, Oeiras (near Lisbon), Portugal. Contact: Prof. Miguel Mota, Department of Gentics, Estacao Agronomica National, 2780 Oeiras, Portugal,

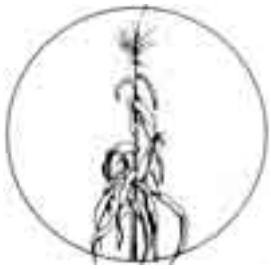
May 10-11 - **Meeting of the National Plant Genetic Resources Board,** Washington, DC. Contact: Charles F. Murphy, Executive Secretary, USDA/ARS, Bldg. 005, Room 29, Beltsville, MD 20705, (301) 344-1560.

May 22-24 - **9th Meeting of EUCARPIA Tomato Working Group,** Wageningen, Netherlands. Contact: H.D.M. Hollander. Institute for Horticultural Plant Breeding, P.O. Box 16, 6700 AA Wageningen, Netherlands.

May 24-29 - **American Association for the Advancement of Science (AAAS) Annual Meeting, New** York. A section on Agriculture and Food will include lectures on research, worldwide food production potential, biotechnology in agriculture, and shortages of agricultural scientists. Contact: AAAS-Dept. R, 1515 Massachusetts Ave.. NW, Washington, DC 20005. Disabled registrants needing special accommodations may contack: Virginia Stern, AAAS Project on the Handicapped in Science, 1776 Massachusetts Ave.. NW, Washington, DC 20036, (202) 476-4497.

June 11-15 - **Gordon Research Conferences.** Andover, New Hampshire. For fee schedule and application forms, contact: Alexander M. Cruickshank, Director of the Gordon Research Conferences, Pastore Chemical Laboratory, University of Rhode Island, Kingston, RI 02281, (401) 783-4011 or 783-3372.

June 18 - **Forage Grass Crop Advisory Committee Meeting, College** Station, Texas, 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, UT 84322, (801) 750-3069.



June 18-22 - **3rd International Society for Horticultural Science Symposium on Quality of Vegetables.** The Agricultural University of Norway, Aas, Norway, sponsored by the ISHS Working Group "Quality of Vegetables" and the Norwegian Food Research Institute. Contact: ISHS Symposium, "Quality of Vegetables," Norwegian Food Research Institute, P.O. Box 50, N-1432 Aas-NLH, Norway.

June 10,20,21 -The **28th Grass Breeders Work Planning Conference,** College Station, Texas. Contact: Byron L. Burson, Secretary, USDA/ARS, Southern Region, Grassland, Soil and Water Research Laboratory, PO Box 748, Temple, TX 76503.

June 24-28 - **American Seed Trade Association Annual Convention,** Denver Marriott, Denver, Colo. Contact: ASTA, 1030 15th St., NW, Suite 964, Washington, DC 20005, (202) 223-4080.

July 12-20 - **Seed Pathology Course,** Western Washington Research and Extension Center of Washington State University, Puyallup, Wash. Contact: Richard L. Gabrielson, Western Washington Research and Extension Center, Washington State University, Puyallup, WA 98371, (206) 593-8530.

July l5-20 - **29th National Alfalfa Improvement Conference,** Lethbridge, Alberta, Canada. Conference will include research papers on alfalfa improvement, a joint session with the Forage Insect Workshop, a tour of Agriculture Canada Research Station, poster session, and visits to seed production areas. Contact: Robert R. Kalton. Land O'Lakes Research Farms, RR #2, Webster City, IA 50595.

August 5-9 - **Annual Meeting of the Botanical Society of America,** Fort Collins, Colo. Organized in cooperation with the American Institute of Biological Sciences and Colorado State University. 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 5-11 - **81st Annual Meeting, American Society for Horticultural Science,** Univ. of British Columbia, Vancouver. Canada. Contact: American Society for Horticultural Science, 701 N. Saint Asaph St., Alexandria, VA 22314, (703) 836-4606.

August 12-16 - **Annual Meeting of The American Phytopathological Society (APS).** Guelph. Ontario, Canada. Held in conjunction with the 1984 Annual Meeting of the Canadian Phytopathological Society (CPS). Contact: Raymond J. Tarleton, APS Headquarters, 3340 Pilot Knob Road, St. Paul, MN 55121, (612) 454-8250.

August 12-l7 - **World Soybean Research Conference III,** Iowa State University, Ames, Iowa. Conference goal is to provide a forum for exchange of information on the broad range of soybean research activities underway throughout the world. Contact: Walter R. Fehr, Department of Agronomy, Iowa State University, Ames, IA 50011.

August 19-23 - **Molecular Basis of Plant Diseases,** University of California, Davis. Contact: William Timberlake, College of Agricultural and Environmental Science, University of California, Davis, CA 95616.

September 10-12 - **Biotech '84 International Conference and Exhibition,** Washington, DC. Second world conference and exhibition on commercial applications and implications of biotechnology. The conference program will be broad-based and run in three concurrent tracks. Reports will be presented on the latest commercially relevant research from universities and institutes, and the activities and progress of the new wave of biotech companies will be investigated (within the limits of commercial secrecy). A call is out for those who wish to present papers, take a booth, or participate as a delegate. Contact: Biotech '84, London OnLine, Inc., Suite 1190, Two Penn Plaza, New York, NY 10121, (202) 279-8890.

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