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Report to the Secretary of Agriculture

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PLANT GERMPLASM

A Data Collection Framework and Questionnaire

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Program Evaluation and
Methodology Division

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October 10, 1990

The Honorable Clayton K. Yeutter
Secretary of Agriculture

Dear Secretary Yeutter:

This is the second of two volumes of our report examining the management of germplasm stores and the National Plant Germplasm System. The report presents our design and demonstration of a new method for obtaining more and complete information relevant to improving the management of the system.

This volume provides technical details on a data collection framework and a questionnaire we designed to obtain information about germplasm resources from plant scientists in the United States and foreign countries. Volume one of the report, entitled Plant Germplasm: Improving Data for Management Decisions, presents an overview of the Agricultural Research Service's efforts to obtain data for decisionmaking relative to germplasm; an explanation of our objectives, scope, and methodology; results of our demonstration of the new method; and conclusions and a recommendation.

This volume will be distributed to those who receive the first volume, and it will be made available to others who request it.

Sincerely yours,

Eleanor Chelimsky
Assistant Comptroller General

Contents

Abbreviations

ARS	Agricultural Research Service
NPGS	National Plant Germplasm System
USDA	U.S. Department of Agriculture

A Framework to Guide Data Collection

This framework presents categories of conditions and activities that affect long-term survival of crops and their associated germplasm for which uniform information can be obtained about many different crops. The information sources are (1) a survey of the opinions and activities of plant scientists who work with crops and germplasm, (2) germplasm managers' knowledge of collections, and (3) statistics that (if available) help describe the status of crops and germplasm resources. Together, these would represent a "snapshot" of the status of each crop surveyed.

The analyses suggested by the framework components below focus on the information obtained from the survey of plant scientists and indicate the quality (availability, completeness, and accuracy) of requested information for different crops. This could help germplasm managers identify gaps in information; trends in germplasm acquisition, preservation, and use; and types of information that are difficult or impossible to obtain.

Analyses of Survey Responses

The framework presents examples of analyses of responses to the survey questions presented in appendix II. Response frequencies, mean, median, or percentage responses, correlation, or other statistics can be applied to describe the data as applicable. The framework presents suggested ways to combine responses from separate questions or parts of questions for an individual crop, species, or genus. Undoubtedly, different or additional combinations would be of interest to the analyst, depending on the crop surveyed and specific management needs.

When these comprehensive data are obtained for a wide range of crops, additional levels of analyses should be applied to compare needs and conditions among crops. Over the long term, the data base of information can be updated as additional crops are surveyed or resurveyed and accessed to identify changes in conditions or trends. For example, the Agricultural Research Service (ARS) might strive to deemphasize some areas where the data indicate a strong effort by others, or it might attempt to coordinate with others to maximize the dissemination of information and minimize duplication of effort.

For many of the analyses presented in the framework, differences in opinions or level of activity among groups of scientists who use germplasm in their breeding or research efforts can be determined by stratifying the groups in various ways, using survey questions 3 through 12—for example, length of time working with the crop; membership in

particular organizations; public sector, university, or private sector researcher; or education level and field of study.

Survey responses obtained from several of the survey questions can be analyzed to obtain scientists' opinions about the relative importance of emphasizing various germplasm management activities. By gaining the opinions of scientists who are users of the resource, ARS could broaden its view of the status of various crops with respect to the need for emphasis among the activities involved in maintaining and using germplasm resources.

Survey questions 29, 48, 53, and 74 provide scientists' opinions of the relative importance of emphasizing genetic resource management activities grouped in the areas of acquisition, preservation, description, and crop improvement, which includes breeding, enhancement, and research. Opinions from question 80 can be analyzed to obtain measures of the differences in emphasis that should be given to six genetic resource management and use activities relative to one another.

Responses can be stratified by groups of scientists with different areas of interest or affiliation, such as public versus private sector orientation. For example, agreement might exist about the need for emphasis regardless of stratification. However, breeders working with a particular crop may not agree on which crop improvement activities should be emphasized, indicating that more in-depth review of the status of those activities may be needed for the crop.

Framework Components

Each framework component is followed by the applicable survey question numbers in appendix II, suggested analyses, and other information that should be collected and analyzed to describe the component.

I. Amount of Stored Germplasm (Acquisition)

A. Identification of Criteria for Acquisition and Storage of Plant Germplasm

In reviewing ARS criteria for decisions about what germplasm to acquire, decisionmakers could evaluate criteria cited as important to the scientists who work with the crop's germplasm and assess recent and planned collection efforts of others to identify duplication of effort, primary sources of funding for collections, and whether coordination with others' collection efforts is possible.

Q13 provides the extent to which scientists use various methods to obtain germplasm, such as exploration or requests from the National Plant Germplasm System (NPGS).

Q14, Q17, and Q18 indicate how many exploration trips have been conducted and are planned, the locations of collection efforts, and funding sources for planned trips.

Q28 provides the factors that are most important in influencing scientists' decisions to acquire genetic resources, and Q22 provides the categories of genetic resources they requested.

Criteria for acquiring germplasm may also involve knowledge of collections that contain germplasm thought to be of value to NPGS. Q41 and Q42 provide the number of scientists who believe they have unique accessions that would be of value to NPGS and whether they have offered the accessions to NPGS. Comparison of these responses indicates how much valuable germplasm may not be offered to the system.

Q43 provides respondents' opinions of why offered accessions were not accepted. Perceived reasons for nonacceptance could help ARS communicate with scientists about criteria for accepting germplasm into NPGS.

Q29 provides respondents' opinions on the extent to which seven acquisition activities should be emphasized to facilitate germplasm management. This information provides a means for ARS to review its own priority-setting from the standpoint of a wide range of scientists working with the genus, species, crop, and so on.

B. Reliable Inventory of Stored Accessions, Which Include Cultivars in Current Use, Obsolete Cultivars, Special Genetic Stocks, Traditional Cultivars (Landraces), and Wild and Weedy Species or Relatives of Cultivated Varieties

Presumably, ARS curators have knowledge of inventories for their own collections. However, more-complete information about collections held by other components of NPGS, and those outside NPGS, might help set priorities for whether to increase the size of NPGS inventories.

Q39 provides information on the number of accessions in each gene pool held in scientists' collections. Also, column 4 provides the number of accessions the scientists sent to others in the last 5 years, another indication of which types of germplasm are being exchanged and used.

Q31 and Q32 (amount of resources held in gene banks) can be analyzed by gene pool to determine scientists' degree of satisfaction with the quality (accuracy and completeness) of information available on the amount of germplasm existing in gene banks and specific sources of the

information. This analysis can identify generally which sources are considered most reliable or in which gene pools the information is considered most or least complete and accurate.

Q22 column 1, for example, can be used to determine the numbers of accessions in each gene pool that respondents requested. Q21 indicates from which sources respondents requested germplasm. With this information, ARS might assess how many scientists do not request germplasm from them in any gene pool or, conversely, in which gene pools for the crop scientists are requesting ARS germplasm.

C. Number of Accessions in Working Collections That Are Backed Up at a Long-Term Facility

ARS should review statistics on percentage of plant introduction station accessions that are stored long-term at the National Seed Storage Laboratory.

In addition to learning of the amount of NPGS germplasm stored long term, ARS could determine what percentage of others' collections for the crop are probably guarded against loss by storage at a long-term facility through responses to Q39 column 3. In addition, Q41 and Q42 ask about unique germplasm that scientists may have offered to NPGS. These questions could give an indication of whether potentially valuable germplasm is in long-term storage.

D. Degree of Access to New Sources of Germplasm and Programmed Collection Efforts

A profile of scientists' access to sources of germplasm can be determined through analysis of Q15, which provides the number of times respondents have attempted to acquire germplasm through exploration in the last 3 years, and Q16, which provides the number of times attempts were unsuccessful and why. Q14 identifies locations where scientists have apparently gained access.

Q24, Q25, Q26, and Q27 indicate the extent to which collected germplasm has been placed in quarantine, how long it has remained there, whether scientists have had access to the germplasm, and whether scientists' work has been hindered as a result of the genetic resources' being in quarantine.

Q18 can identify duplication in trips planned or funded to the same locations for different crops, to allow for possible coordination.

Also, Q14 and Q18 provide the locations where scientists have collected and plan to collect and Q19 where they believe collection should occur. Such information could supplement ARS data on the extent locations have been accessed or where information might exist outside ARS on

potential acquisition sites. Also, ARS could identify where private or other funding is already arranged for collection and could save all or part of the cost of collection if opportunities for coordination are possible.

E. Degree of Access to Information About Germplasm

Q23 rows 1, 2, 3, and 4 provide the frequency with which respondents encountered problems with information about accessions they received and the extent the problems hindered their work.

Q50 indicates the reasons respondents do not request descriptive information from sources of germplasm, such as inaccessible data bases or belief that existing information is not complete or accurate. Q51 provides the types of germplasm information most important to scientists' work and whether the information is hard or impossible to obtain.

II. Endangered Geographic Sites of Origin

A. Knowledge of World Locations Where Traditional Cultivars (Landraces) and Wild and Weedy Species or Relatives of Cultivated Varieties Are Declining

Statistics should be obtained by the U.S. Department of Agriculture (USDA), the International Board for Plant Genetic Resources, or other sources. ARS should use the following information as part of an effort to identify and access locations where germplasm collection may be a high priority. Q28 row 2 (in the great or very-great importance columns) indicates the number of scientists whose decisions to acquire genetic resources were influenced by knowledge of sites where wild and weedy species or traditional varieties are in danger of loss. Row 8 indicates that the ability to gain access to collection sites influenced decisions. For these respondents, Q14 and Q18 provide locations where exploration might have taken place or is planned. Q29 row 1, compared to other rows, could indicate scientists' opinions about the importance of acquiring endangered genetic resources for the crop versus other crops.

B. Number of Declining Species or Cultivars

Statistics should be obtained by ARS, the International Board for Plant Genetic Resources, or other sources.

Q31 (amount of resources declining) provides scientists' degree of satisfaction with the accuracy and credibility of information they obtained on the amount of genetic resources that are in decline, by category of genetic resource. Q32 provides scientists' degree of satisfaction with the information from specific sources—for example, NPGS, international research centers, or individual scientists.

C. Acres of Traditional Cultivars and Wild and Weedy Relatives That Are Lost From Natural and Societal Pressures	Statistics should be obtained by ARS, the International Board for Plant Genetic Resources, or others to identify the extent of loss of genetic resources from encroaching industrialization, and other factors.

III. Condition of Stored Germplasm (Preservation)

A. Probable Viability of Accessions Upon Receipt or Prior to Storage	Knowledge of the general condition of the germplasm that scientists received from various sources for a particular crop would be useful in assessing the overall differences among the viability of collections. Q23 rows 6 and 7 provide the frequency with which scientists received germplasm with low viability or insufficient seed quantity and the extent to which these problems hindered their work. Row 1 indicates how often data on germination rates were not provided with the material.
B. Probable Viability of Accessions Being Held in Storage	It is possible that many accessions from individuals' collections are distributed to other scientists (Q39 rows 1 and 4), and depending on the level of maintenance of these collections, breeders and researchers may not be exchanging high-quality material. ARS might determine that for a particular crop more attention is needed to ensure that NPGS is adequately preserving germplasm and that high-quality material is available to users. Q44 identifies percentages of various forms of germplasm such as seed, clones, or in vitro culture stored in scientists' collections. Q45 provides the types of storage conditions scientists report they are regulating for their collections and Q46 the maintenance activities they usually perform. Q46 rows 1 and 2, in particular, can be tabulated to determine how many of these scientists usually germinate seed prior to and after placing it in storage. Q51 row 7 provides the level of importance scientists place on getting health and viability information on accessions and whether the information is hard or impossible to obtain.

C. Adequacy of Regeneration, Grow-Out, and Germination Testing Procedures and Standards Used to Maintain the Integrity of the Accessions

Q46 frequencies for all rows indicate which maintenance activities scientists perform on their collections, and Q47 indicates which standards, if any, they follow.

D. Adequacy of Conditions Necessary to Preserve and Maintain Stored Accessions of Germplasm

Q37 helps identify scientists who keep germplasm for particular periods of time, and Q45 can indicate whether the scientists regulate or record storage conditions.

For scientists who regulate or record conditions, ARS could compare frequencies of Q47 row 1 (no standards applied to germplasm maintenance) with rows 2 through 6 to determine the proportion of scientists who hold collections and are following preservation standards and which standards they are following.

E. Identification and Control of Pathogens (Fungal, Bacteria, Nematodes), Viruses, Insects, or Rodents in Stored Accessions

In assessing the potential vulnerability of germplasm held in collections, it is important to know how much emphasis scientists are placing on the identification and control of pests or disease. Q45 rows 5 and 7 indicate how many scientists include control of disease, insects, and rodents in their germplasm maintenance activities. Also, Q46 row 5 indicates the extent to which scientists test for or treat viruses and pathogens.

Q66 frequencies for rows 5, 6, and 8 indicate how many scientists focus their research objectives on identifying resistance to pathogens, pests, or other environmental stresses or deterioration in stored accessions.

Q48 row 4, when compared with other rows, indicates the extent to which scientists believe detecting and treating diseases and insects in storage should be emphasized as part of the preservation activities for a particular crop.

IV. Status of Description of Stored Germplasm (Evaluation)

A. Type of Descriptive Information on Germplasm That Is Important and Available to Germplasm Users

We are defining descriptive information as the results of germplasm evaluations and passport and other taxonomic information and otherwise describing preserved genetic resources. We believe that ARS should be aware of the needs of scientists who work with germplasm, including what types of descriptive information are most important to their work.

ARS decisions on setting priorities among crops for various activities could be assisted and supported by knowledge of what scientists think is most important.

Q51 provides the relative importance of various types of information describing germplasm to scientists' work and whether the information was hard or impossible to obtain.

Q53 provides scientists' opinions, by crop, on the extent to which five germplasm description activities should be emphasized.

Q23 rows 2, 3, and 4 indicate how often scientists received incorrect data or descriptions or no description on the germplasm they requested and the extent the problems hindered their work.

Q52 provides scientists with suggestions of the additional types of descriptive information that might assist them.

B. Type and Availability of Germplasm Evaluation Data Produced by Germplasm Users

Evaluation results obtained from scientists who request germplasm may be useful to ARS and may reduce duplicative effort. ARS could identify how much data are available and accessible, whether scientists are sending their evaluation results to requesters, and why they do not comply with such requests.

Q66 row 9 and other selected rows can provide the number of scientists who emphasize evaluation of gene bank accessions or identification of traits or gene mapping as objectives in their breeding or research programs. Q54 provides the approximate number of accessions evaluated by scientists during the past 3 years. Questions 55-58 indicate whether the resulting data are recorded, available, and easily retrieved.

Q60 provides the percentage of time scientists have been asked to send evaluation results back to the provider of germplasm. Q61 provides the percentage of time they provided the requested data, and Q62 indicates the reasons they did not provide the data.

V. Emphasis in Research and Breeding Programs (Including Enhancement)

A degree of knowledge on the research and breeding objectives scientists emphasize most and their rationale for the emphasis can help ARS set priorities for enhancement, evaluation, and breeding efforts in a manner that responds to scientists' needs, if appropriate.

A. Level of Production (in Area, Weight, or Volume) and Value (in Dollars) of Commercial Varieties	Statistics should be obtained by ARS, the International Board for Plant Genetic Resources, or others.
B. Level of Effort in Breeding and Research Programs	Q63 provides data on full-time-equivalent staff working on the crop or genus. This information could be stratified by public or private sector. Q64 provides estimates of funding received for breeding and research, and Q65 provides the percentage of funding supplied by various sources. The amount and sources of funding and full-time-equivalent staff could help ARS identify gaps (or overinvestment) in effort among crops, thus helping direct limited ARS funds to crops needing the most attention. ARS could compare among crops, for example, the percentage of total full-time-equivalent staff dedicated to breeding and research for a crop (Q63). The percentage of such staff dedicated to particular areas of emphasis could reveal trends in the type of research being done, and the specific objectives from Q66 could provide more detail on the differences in emphasis among crops.
C. Degree of Emphasis on Collecting and Preserving Germplasm in Conjunction With Breeding and Research	Several rows in Q66—for example, 7, 8, and 9—indicate breeding or research objectives that involve preserving or evaluating stored germplasm. ARS could compare among crops the proportion of scientists who indicate these objectives are emphasized to a great or very great extent. Percentage of full-time-equivalent staff (Q63) or total funding (Q64) invested in crop improvement, preservation efforts, or basic research can be compared among crops. Such staff or funding levels could be compared with the number of accessions scientists used in their efforts (Q68) to further assess trends in the use of genetic resources among crops. For example, for the top quartile of full-time-equivalent effort in one crop, the number of accessions requested (Q22) or used (Q68) in a given gene pool might also be high, while for another crop in the same quartile, use may be very low, indicating that for whatever reason germplasm is not needed or is not being requested.
D. Type and Cost of Breeding and Research Focused on High Production or High Value Cultivars Versus Those of Lower Commercial Value	The level of effort (Q63) can be compared with levels of production and commercial values of crops. This could result in assessing the extent to which level of effort is correlated with the economic value of the crop but could also indicate where gaps in research or breeding objectives appear to exist (Q66) or could identify efforts that ARS believes are inappropriately low or high for the value of the crop or other factors. This

could provide some support for adjusting funding levels for research, enhancement, or breeding efforts.

The number of Q67 responses (in the great or very-great extent columns) indicates the factors that most influenced scientists' decisions to develop and conduct research or breeding efforts. Differences in the factors that are important among crops of higher and lower commercial value might indicate areas of concern about potential vulnerability of the crops or trends in economic, social, or political factors affecting direction of breeding and research efforts.

E. Level of Government and Private Funding or Full-Time-Equivalent Staff Invested in Developing Various Types of Plant Germplasm

Private and public sector full-time-equivalent staff and funding directed to various crops can be compared with the extent of requests for germplasm (Q22) and with use of germplasm from gene pools 1, 2, and 3 (Q68) in the breeding or research programs. This could help ARS make decisions about which crops should be given attention in acquisition or enhancement or where it believes the use of wild germplasm should be encouraged.

F. Influence of Yearly Demand for Hybrid Seed or Ability to Produce Cultivars

Statistics on demand for hybrid seed and numbers of cultivars produced should be obtained by USDA, International Board for Plant Genetic Resources, or others.

With the statistics and the overall results of Q67, row 7, the importance of current and potential demand for hybrids, and row 8, importance of production of cultivars as factors in decisions to develop or conduct programs, can be compared among crops.

G. Influence of Amount of Domestic Use Versus Export of the Crops

Statistics on amount of domestic use and export of crops should be obtained from USDA, International Board for Plant Genetic Resources, or others.

With the statistics and the overall results for Q67, a comparison can be made between crops from row 9, the importance of domestic consumption, and row 10, the importance of demand for export to other countries, as factors in decisions to develop or conduct programs.

H. Influence of Number of Uses for the Cultivars (e.g., Food, Forage, Fiber, Fuel)

Statistics on the number of uses for the crops should be obtained by USDA, International Board for Plant Genetic Resources, or others.

With the statistics and the overall results for Q67, a comparison can be made between crops on the importance of row 11, on current and potential uses for the crop, and row 12, on the importance of pressure from

crop producers or end user groups in influencing scientists' decisions to develop or conduct their program.

I. Changes in Research Emphasis From Development or Use of Advanced (Biotechnology) Techniques

Scientists' survey responses will help identify the extent to which advanced techniques (biotechnology tools) are used in breeding and research programs and whether their use is influencing program objectives or the type of genetic resources used by respondents.

ARS could determine the percentage of scientists using advanced (biotechnology) techniques in their breeding and research programs. Q76 provides the extent to which each of seven techniques is used and the extent to which the techniques have changed the respondents' breeding or research emphasis.

Q66 row 14 indicates how many scientists have research objectives focused on the improvement of biotechnology techniques.

Q77 provides the extent to which scientists expect the techniques to change the emphasis or objectives of their efforts. For respondents who report, for example, that a particular technique is expected to change their breeding or research efforts, Q66 column 1 can be compared to column 2 to determine significant changes expected in the next 3 years.

Q78 and Q79 indicate whether the use of biotechnology is causing increases or decreases in the amount and type of germplasm used in the three gene pools. For scientists who report a change, and who say they are using germplasm from gene pools 2 and 3 in their breeding or research (Q68), their breeding and research objectives from Q66 can be evaluated to better understand how advanced techniques are influencing use of wild germplasm and how the techniques are being incorporated into breeding and research efforts.

VI. Susceptibility of Cultivars to Disease, Pests, and the Environment

A. Total Number of Cultivars Planted Annually in the United States and Worldwide

Statistics should be obtained by USDA, International Board for Plant Genetic Resources, and others.

B. Total Acres (or Hectares or Metric Tons) of Cultivars Lost Annually From Disease, Pests, and the Environment

Statistics should be obtained by ARS, the International Board for Plant Genetic Resources, and others.

To analyze the availability and quality of information about the cultivars being lost (or genetic resources being lost from all gene pools), ARS could compare scientists' opinions about information they have obtained. A comparison among crops could indicate where more attention is needed to develop better information.

Q31 (amount of resources declining) provides scientists' degree of satisfaction with the accuracy and credibility of information they obtain on the amount of resources declining in the three gene pools. Q32 provides satisfaction with the information obtained from various sources.

C. Amount and Type of Ongoing Research on Known Stresses for Which Traits for Resistance or Immunity Have Not Been Found

Using the overall results of research and breeding objectives in Q66, ARS could determine the number of great and very-great extent responses for rows 5 and 6. This indicates level of emphasis in breeding and research programs in identifying traits for resistance to known diseases and pests and for greater adaptation to environmental stresses. This information could be compared with full-time-equivalent staff reported by those respondents.

ARS could also determine how many scientists are to a great extent conducting their research or breeding programs because of pests, diseases, or environmental stresses that endanger crops (Q67 rows 2 and 4).

Q70 provides a list of specific resistance traits for which scientists are currently searching and can be compared with Q73, a list of specific resistance traits they believe need greater emphasis as research priorities. From this, important traits may be identified that are receiving little or no attention. In addition, Q72 indicates the extent to which respondents believe descriptors listed by major organizations include those that should be priorities.

VII. Size of Genetic Base

The size of the genetic base of commercial crops has been described in terms of acreage planted with few varieties of a crop, a condition that could potentially cause widespread loss of the crop if one or more of the varieties fell susceptible to a new disease or pest.

Analyses of survey results in this category are intended to describe breeders' and researchers' efforts in the acquisition and use of germplasm from gene pools 1, 2, and 3, to identify trends in breeding and

research objectives that ARS decisionmakers believe focus on identifying new sources of diversity or could potentially expand the base of commercial crops.

A. Extent of Use of Germplasm From Gene Pools 1, 2, and 3 by Plant Breeders and Researchers

Q22 for all rows (the three gene pools) provides the number of accessions requested and received in the past 3 years and the number used currently and planned in the next 3 years (Q68).

Q39 columns 1 and 2 for all rows provides the number of unique and duplicated accessions in scientists' collections, and column 4 provides the number of accessions they distributed to others in the past 3 years.

Q66 row 11 provides the emphasis scientists place on identifying new sources of genetic variation as the objective in their breeding and research programs. Also, the objectives in Q66 can be crosstabulated with Q68 to obtain the extent to which they use wild germplasm in their efforts.

Q68, indicating a great extent of use or planned use of wild germplasm in breeding or research efforts, can be crosstabulated with Q63, the full-time-equivalent staff effort, or Q64, the level of funding to develop trends in the relative size of efforts that incorporate wild germplasm.

B. Number of Cultivars in Current Use, Obsolete Cultivars, Special Genetic Stocks, Traditional Cultivars (Landraces), and Wild and Weedy Species or Relatives of Cultivated Varieties Existing Worldwide

Statistics on estimated numbers of these different types of genetic resources in the genus or species should be obtained, if available. The following analyses attempt to discern scientists' experiences with the accuracy and credibility of information they have obtained.

Q30, Q31, and Q32 (amount of resources in existence) provide an indication of how many scientists working with the crop have obtained information on the number of genetic resources that exist in each gene pool and their level of satisfaction with the accuracy and credibility of the information as well as with various sources of the information. Q33 provides the reasons why respondents did not obtain the information.

C. Amount of Diversity Present in Cultivars in Current Use, Obsolete Cultivars, Special Genetic Stocks, Traditional Cultivars (Landraces) and Wild and Weedy Species or Relatives of Cultivated Varieties Existing Worldwide

Information on the amount of diversity believed to be inherent in a genus or species should be included in decisions whether to invest in additional acquisition versus other activities needed in managing a crop. Knowing the extent to which breeders and researchers cite lack of diversity in the genus as an important factor in their decisions to acquire germplasm compared to other factors, or the extent to which measuring diversity is an important objective of their work, could have implications for ARS's own decisions on how to invest time and money.

Q34 row 1 provides scientists' estimates of the number of subspecies, races, and varieties that exist in the cultivated and wild states.

Q28 rows 1-5, for example, if particularly emphasized for a crop, might indicate that lack of diversity is an important influence over users' acquisition of genetic resources.

Responses for Q66 rows that could potentially result in measures of diversity—for example, rows 5, 6, 9, 10, 11, and 12—can be crosstabulated with full-time-equivalent staff (Q63) or funding (Q64) to determine trends in levels of effort emphasizing these research objectives versus others.

D. Amount of Diversity in Existing Collections

In evaluating the need to increase the diversity in particular collections, decisionmakers should be assisted by knowledge of the diversity believed to be contained in collections held by scientists at universities and private industry. ARS could, for example, assess differences among crops in the importance scientists place on obtaining a description of the expected diversity in accessions they receive and the difficulty experienced in obtaining such information.

Q34 row 2 provides opinions on the number of subspecies, races, and varieties in the cultivated and wild states represented in gene banks, and Q35 provides scientists' opinions on the percentage of existing diversity represented in gene banks.

Q39 column 1 provides the number of accessions in each gene pool contained in scientists' own collections, and Q40 provides estimates of the percentage of existing diversity believed to be represented in those collections. This could allow comparison among crops of estimated levels of diversity overall in collections to assess whether lack of diversity in collections should be a criterion for acquisition decisions.

Q51 row 8 provides an indication of the importance to scientists of information on the extent of expected diversity in accessions received and whether scientists have found such information hard or impossible to obtain.

Survey Concerning Plant Genetic Resources

United States General Accounting Office

Survey Concerning Plant Genetic Resources

INTRODUCTION

This survey is being sent to you as part of an effort to obtain a status of the preservation and use of specific genetic resources from the perspective of scientists who use the resources in their crop improvement and other research efforts. At this time, we are asking for your opinions about the availability and reliability of information for one crop, species, or genus which is specified in the survey. We are also asking for your opinions about levels of emphasis you believe should be placed on various genetic resource management activities. These responses, obtained from a wide range of genetic resource users and combined with other genetic resource management information or statistics, can help gauge the relative vulnerability of genetic resources.

You are asked to respond based on your overall professional knowledge and experience with the specified crop, genus, or species, applying the most global view of genetic resource needs possible. The survey is being sent to plant scientists, world-wide, in many disciplines and with differing interests. It will be implemented for many crops, to assist the U.S. Department of Agriculture in obtaining uniform and comparable information for use in genetic resource management decisionmaking.

The survey is comprehensive, covering the areas of plant genetic resource acquisition, preservation, description, and crop improvement and research. Completing the survey should take about 1 1/2 to 2 hours of your time. Some of the survey questions pertain to your requests for genetic resource material, your objectives and rationale for your work emphasis, and the size and type of any genetic resource collections you maintain. For such questions, please estimate numbers of accessions, or percents, if possible and try not to spend a lot of time consulting records for detailed information. Also, please keep in mind that this survey instrument will be used to obtain information about many different types of crops, and therefore, some response choices may not seem applicable for every crop.

Please return the completed survey in the enclosed pre-addressed envelope within 2 weeks of receipt. If you have any questions, please call----------.

BACKGROUND

This section provides information about respondents to facilitate analysis by respondent groupings, and to assist with future implementation of the survey.

1. Please list the plant genera you have worked with (e.g., researched, maintained or been responsible for) during the past 5 years.

   _____

   _____

   _____

2. Have you worked with *Genus* in the last 5 years? *(Check one)*

   1. ☐ Yes (*Continue with the remainder of the questionnaire.*)
   2. ☐ No (*Stop. Please return questionnaire in the enclosed envelope.*)

Note: For the remainder of the questionnaire, please consider only *Genus* when answering questions.

1

3. For how many years have you worked with *Genus? (Check one.)*

   1. ☐ 2 years or less
   2. ☐ Over 2 to 4 years
   3. ☐ Over 4 to 8 years
   4. ☐ Over 8 to 16 years
   5. ☐ Over 16 to 32 years
   6. ☐ Over 32 years

4. How many subcategories of the specified genus, species, or crop have you worked with extensively in the past 5 years? (*List the number of subcategories you have worked with for each species. Since levels of taxonomy, terminology for classification, and opinions about terminology differ among crops, please circle the term below, that you believe best describes the subcategories:*)

   SUBSPECIES RACE VARIETY

   OTHER_____

Species name(s)	Number of subcategories worked with
1.	
2.	
3.	
4.	
5.	
6.	

5. In what country and state or province are you working?

   _____

6. At what type of organization do you currently conduct the major portion of your work? (*Check the one that best describes your organization.*)

   1. ☐ Public agency
   2. ☐ Private company
   3. ☐ University
   4. ☐ Non-profit foundation
   5. ☐ Do not conduct work at an organization (retired, or use plant genetic resources for a hobby or avocation)
   6. ☐ Other *(specify)*

      _____

      _____

7. Is this organization based in the U.S., or in another country or is it international? *(Check one.)*

   1. ☐ U.S. based
   2. ☐ Non U.S. based
   3. ☐ International

8. What is your current position/title with the organization above?

   _____

9. Which of the following disciplines do you consider to be your **most important** fields of study or activities at this time? (*Check up to four choices*)

1. ☐ Agricultural economy
2. ☐ Agronomy/soil science
3. ☐ Biochemistry
4. ☐ Botany
5. ☐ Biology (molecular or cellular)
6. ☐ Cytogenetics
7. ☐ Ecology
8. ☐ Entomology
9. ☐ Genetics
10. ☐ Nutrition
11. ☐ Horticulture
12. ☐ Plant breeding
13. ☐ Plant pathology/virology
14. ☐ Plant physiology
15. ☐ Taxonomy
16. ☐ Curator
17. ☐ Research director
18. ☐ Other (*specify*)

_____

10. What is the highest level of education that you have attained? (*Check one.*)

1. ☐ Less than 4 years of college
2. ☐ Bachelor's degree or equivalent
3. ☐ Master's degree or equivalent
4. ☐ Doctoral degree or equivalent
5. ☐ Post doctoral study or equivalent
6. ☐ Other (*specify*)

_____

11. Of which of the following committees or organizations are you currently a member? (*Check all that apply.*)

1. ☐ U.S. Crop Advisory Committee (CAC)
2. ☐ U.S. Technical Advisory Committee (TAC)
3. ☐ U.S. National Plant Germplasm Committee (NPGC)
4. ☐ U.S. National Plant Genetic Resources Board (NPGRB)
5. ☐ Any International Board for Plant Genetic Resources (IBPGR) Committee
6. ☐ Conservation Groups
7. ☐ Crop specific associations
8. ☐ Agricultural or horticultural associations
9. ☐ Other professional associations
10. ☐ Amateur crop or plant oriented associations
11. ☐ Botanical gardens
12. ☐ Other (*specify*)

_____

13. ☐ None

12. During the last year about what percent of your time was spent working with ***Genus***, other crops, and other activities? (*Percents should total 100.*)

    1. _____% Direct work with ***Genus***
    2. _____% Direct work with other crops
    3. _____% Administrative, management, support, and other activities not directly related to ***Genus*** or other crops

ACQUISITION OF *GENUS* PLANT GENETIC RESOURCES

This section provides information that can help genetic resource managers assess the needs of genetic resource users, and make decisions about acquiring resources.

13. **Please** indicate the extent, if at all, to which you use each of the following methods to acquire plant genetic resources? *(Check one column for each row)*

Acquisition Methods	Extent of Emphasis: Little or no extent (1)	Some extent (2)	Moderate extent (3)	Great extent (4)	Very great extent (5)
1. Formal plant exploration trips conducted by you or others					
2. Personal trips (not associated with a formally arranged exploration trip)					
3. Request or exchange with U.S. National Plant Germplasm System (NPGS) gene banks or clonal repositories					
4. Request or exchange with gene banks or clonal repositories other than NPGS					
5. Request or exchange with individual scientists					
6. Ordering from seed companies, catalogs, etc.					
7. Other *(specify)*					

Plant Exploration Trips

14. **Please** list the locations from which, in the past five years, you obtained *Genus* genetic resources through plant exploration trips planned by you or people you know. (By location we mean country and region, state, or province). If you have not obtained genetic resources in this manner, write NONE.

Locations of wild and weedy genetic resources_____

Locations of cultivated genetic resources_____

15. In the past three years, have you **attempted** to acquire ***Genus*** genetic resources through plant exploration trips arranged by yourself or people you know? *(Check one.)*

1. ☐ Yes_____ (Number of attempts)
2. ☐ No (*GO TO QUESTION 17*)

16. How many times, if at all, have you been **unable** to acquire genetic resources from plant exploration trips cited in question 15 for each of the following reasons? (*Write 0 if none*).

Reasons For Inability to Acquire	Number of Times Unable to Acquire
1. Host country restrictions	
2. Inability to identify appropriate channels or make contacts	
Lack of funding provided for exploration	
3. Funding was denied	
4. Exploration proposal was accepted; no funding was available	
5. Exploration proposal was not accepted; funding was available	
6. Other (*specify*)	

17. Do you plan to acquire ***Genus*** plant genetic resources through plant exploration trips arranged by yourself, or people you know, in the next 3 years? *(Check one.)*

1. ☐ Yes
2. ☐ No (*GO TO QUESTION 19*)

18. **Please provide information about the location, number, and funding of the above trips.** *(Write the location, number of trips planned, and number funded in the appropriate columns. Check no basis to judge, if appropriate.)*

	Trips Planned/Funded				Source(s) of Funding												
Location	Number of trips planned (1)	Number partially funded (2)	Number fully funded (3)	No basis to judge (4)	International source (e.g., FAO) (1)	Government sources in countries other than the USA (2)	USDA/CSRS competitive grants (3)	USDA/ARS exploration grants (4)	Other U.S. federal agencies (5)	Other State agencies (6)	Universities (7)	Private industry (8)	Private foundations (9)	Professional associations (10)	User or membership fees (11)	Own personal funds (12)	Other (specify) (13)
1.																	
2.																	
3.																	
4.																	
5.																	

19. **From what areas of the world (country and region, state, or province) do you believe *Genus* genetic resources are underrepresented in collections, and should be collected regardless of whether a trip is planned to collect there? Also, which species, subspecies, varieties, or races, etc. should be collected?** *(Please list any locations that you believe should be considered.)*

World locations for collection	Resources that should be collected from each location
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____

Experiences With, and Opinions About Requesting and Obtaining *Genus* Genetic Resources

20. Have you requested or obtained ***Genus*** genetic resources from any individual or organization in the past 3 years? *(Check one.)*

    1. ☐ Yes
    2. ☐ No (*GO TO QUESTION 24*)

21. In the past 3 years, which categories of ***Genus*** genetic resources did you request, and from what sources did you request them? *(Indicate your answer by checking the appropriate box in the row column matrix. Leave blank if you did not request a resource from a specific source.)*

Categories of Plant Genetic Resources	Sources: U.S. Agricultural Research Service/GRIN (1)	U.S. State Agricultural Experiment Stations (2)	Individual U.S. Scientists (3)	Individual scientists from countries other than the USA (4)	International Research Centers, e.g. CIMMYT, ICRISAT (5)	Your own organization's collections (6)	Other private companies/seed companies (7)
1. Cultivars in current use							
2. Obsolete cultivars							
3. Traditional varieties (landraces)							
Gene pool 2							
4. Distant relatives of cultivated varieties that form fertile hybrids							
5. Biological species that can be crossed using conventional methods but with a high level of sterility							
Gene pool 3							
6. Biological species that can be crossed only by use of advanced techniques							
Other							
7. Special genetic stocks							
8. Breeding populations							
9. Other (*specify*)							

22. Please estimate the number of accessions or samples in each category of genetic resource that you requested or received in the past 3 years from any of the sources in question 21. (*Write the number or leave blank if none*).

Categories of Plant Genetic Resources	Number of Accessions: Requested (1)	Number of Accessions: Received (2)
Gene pool 1		
1. Cultivars in current use		
2. Obsolete cultivars		
3. Traditional varieties (landraces)		
Gene pool 2		
4. Distant relatives of cultivated varieties that form fertile hybrids		
5. Biological species that can be crossed using conventional methods but with a high level of sterility		
Gene pool 3		
6. Biological species that can be crossed only by use of advanced techniques		
Other		
7. Special genetic stocks		
8. Breeding populations		
9. Other (*specify*)		

23. Indicate below how often, if at all, you encountered the following problems with the accessions you requested. Also indicate the extent, if at all, the problem hindered your work. (*Check one column under each heading for each row.*)

Problems Encountered	1-How Often Encountered: Never (1)	Seldom (2)	Some of the time (3)	As often as not (4)	Most of the time (5)	Almost always (6)	2-Extent Hindered Work: Little or no extent (1)	Some extent (2)	Moderate extent (3)	Great extent (4)	Very great extent (5)	No basis to judge (6)
1. Data on germination rates were not provided												
2. Incorrect data on types of genetic mechanisms involved (e.g., quantitative or mendelian)												
3. Lack of description												
4. Incorrect description												
5. Duplicates instead of the unique accessions requested												
6. Resources had low viability												
7. Insufficient seed quantity received												
8. Shipping delays												
9. Quarantine indexing or processing problems												
10. Wrong genetic resources provided												
11. No genetic resources provided												
12. Other (*specify*)												

24. Have any genetic resources you obtained been placed in quarantine? (*Check one.*)

1. ☐ Yes
2. ☐ No (*GO TO QUESTION 28*)

25. To what extent, if at all, have you had access to your genetic resources while they were in quarantine? *(Check one.)*

1. ☐ Little or no extent
2. ☐ Some extent
3. ☐ Moderate extent
4. ☐ Great extent
5. ☐ Very great extent

26. Please estimate the average time in months and years that your genetic resources have remained in quarantine.

Months_____Years_____

27. To what extent, if at all, has the quarantine time period hindered your work? *(Check one.)*

1. ☐ Little or no extent
2. ☐ Some extent
3. ☐ Moderate extent
4. ☐ Great extent
5. ☐ Very great extent

Factors Influencing *Genus* Acquisition

28. In the past 3 years, how important, if at all, were the following factors in influencing your decisions whether or not to acquire particular genetic resources? (*Please check the appropriate column for each of the factors listed below.*)

Factors Influencing Decisions	Level of importance: Little or no importance (1)	Some importance (2)	Moderate importance (3)	Great importance (4)	Very great importance (5)
1. Genetic resources stored in collections do not contain traits needed for research or plant breeding					
2. Knowledge of sites where wild and weedy species or traditional varieties are in danger of loss					
3. Diversity stored in collections world-wide is insufficient to assure survival of species within the genus					
4. Research results measuring allelic frequencies indicate a lack of diversity in the genus					
5. Overall concern for genetic uniformity of crops					
6. Availability of resources well adapted to particular environments					
7. Commercial interest in the crop					
8. Ability to gain access to collection sites					
9. USA's regulations, practices, or changes in policy that inhibit the importation of genetic resources					
10. Countries' (other than the USA) regulations, practices or changes in policy that inhibit the exportation of genetic resources					
11. USA Crop Advisory Committee recommendation to collect genetic resources					
12. Availability of resources to conduct collection expeditions					
13. Scientific curiosity/discovery					
14. Availability of facilities to store and maintain collected resources					
15. Other (*specify*)					

29. To what extent, if at all, do you believe the following acquisition activities and events need to be emphasized to facilitate the overall management of ***Genus*** plant genetic resources? *(Please check one column for each row)*

Acquisition	Extent of Emphasis: Little or no extent (1)	Some extent (2)	Moderate extent (3)	Great extent (4)	Very great extent (5)	No basis to judge (6)
1. Acquiring endangered genetic resources whether or not their potential is known						
2. Acquiring genetic resources that are considered to be potentially useful in plant breeding						
3. Acquiring genetic resources of unknown potential whether or not they are endangered						
4. Improving quarantine procedures and regulations to facilitate acquisition						
5. Eliminating political barriers that hinder collection						
6. Developing arrangements for minimizing patent restrictions in consideration of access to genetic resources						
7. Improving knowledge and techniques for collecting and recording accessions						
8. Other (*specify*)						

Opinions About Availability and Accuracy of Information Concerning *Genus* Genetic Resources in Existence

30. Have you obtained any information from any source, including your own research, about the amount of ***Genus*** genetic resources that exist in the cultivated or wild state or in gene banks, or about the amount that are declining due to human and other pressures? *(Consider the range of species, subspecies, races, varieties, etc.). (Check one.)*

1. ☐ Yes
2. ☐ No *(GO TO QUESTION 33)*

31. For each of the 6 genetic resource categories listed below, how satisfied were you with the overall accuracy and completeness of information obtained? Answer for (1) information on the amount of genetic resources existing in the cultivated and wild state, (2) information on the amount of genetic resources held in gene banks, and (3) information on the amount of genetic resources that are declining due to human and other pressures. (*Check no basis to judge if you have not obtained information about a specific resource category ,or you do not have enough information to rate quality*).

Sources	Amount of Resources in Existence				Amount of Resources Held in Gene banks				Amount of Resources Declining			
	No basis to judge (1)	Generally dissatisfied (2)	As satisfied as not or undecided (3)	Generally satisfied (4)	No basis to judge (1)	Generally dissatisfied (2)	As satisfied as not or undecided (3)	Generally satisfied (4)	No basis to judge (1)	Generally dissatisfied (2)	As satisfied as not or undecided (3)	Generally satisfied (4)
Gene pool 1												
1. Cultivars in current use												
2. Obsolete cultivars												
3. Traditional varieties (landraces)												
Gene pool 2												
4. Distant relatives of cultivated varieties that form fertile hybrids												
5. Biological species that can be crossed using conventional methods but with a high level of sterility												
Gene pool 3												
6. Biological species that can be crossed only by use of advanced techniques												

32. For each of the 10 **information sources or providers** listed below, how satisfied were you with the overall accuracy and completeness of information obtained? As with the previous question, answer for (1) information on the amount of genetic resources existing in the cultivated and wild state, (2) information on the amount of genetic resources held in gene banks, and (3) information on the amount of genetic resources that are declining due to human and other pressures. (*Check no basis to judge if you have not obtained information from a specific source or you do not have enough information to rate quality.*)

Sources	Amount of Resources In Existence				Amount of Resources Held in Gene banks				Amount of Resources Declining			
	No information obtained (1)	Generally dissatisfied (2)	As satisfied as not or undecided (3)	Generally satisfied (4)	No information obtained (1)	Generally dissatisfied (2)	As satisfied as not or undecided (3)	Generally satisfied (4)	No information obtained (1)	Generally dissatisfied (2)	As satisfied as not or undecided (3)	Generally satisfied (4)
1. U.S. Agricultural Research Service (ARS) or GRIN												
2. U.S. State Agricultural Experiment Stations												
3. U.S. Crop Advisory Committee (CAC)												
4. Individual U.S. scientists												
5. Your own research												
6. International Board for Plant Genetic Resources (IBPGR)												
7. Individual scientists from countries other than the USA												
8. International Research Centers, e.g. ICRISAT, CIMMYT												
9. Scientific/technical publications												
10. Other (*specify*)												

33. In instances when you have not obtained information on the amount and decline of genetic resources, which of the following reasons describe why not? *(Check all that apply.)*

    1. ☐ Did not request information
    2. ☐ Information is not needed
    3. ☐ Information probably does not exist
    4. ☐ Information is not accessible
    5. ☐ Information is not accurate or complete enough to be useful
    6. ☐ Other (*specify*)

    _____

34. Based on information you have obtained and/or your best professional opinion, please estimate the number of ***Genus*** subspecies, races, or varieties, etc. that exist in the cultivated and wild state, worldwide, and the number held in gene banks.

    1. _____ Number in existence
    2. _____ Number held in gene banks
    3. ☐ No basis to judge

35. Consider the total amount of genetic diversity that exists in each category of ***Genus*** genetic resource. If you can, please **estimate the percent of each category total** that you believe is represented in gene banks. If you feel that you do not have enough information to even make an intelligent guess, check no basis to judge.

Categories of Genetic Resources	% of the total diversity in gene banks	No basis to judge
Gene pool 1		
1. Cultivars in current use	%	
2. Obsolete cultivars	%	
3. Traditional varieties (landraces)	%	
Gene pool 2		
4. Distant relatives of cultivated varieties that form fertile hybrids	%	
5. Biological species that can be crossed using conventional methods but with a high level of sterility	%	
Gene pool 3		
6. Biological species that can be crossed only by use of advanced techniques	%	

PRESERVATION OF *GENUS* PLANT GENETIC RESOURCES

This section is intended to provide a profile of on-going preservation activities performed by public and private sector plant scientists in conjunction with their breeding or research programs, and to help identify collections containing material believed to be important to the U.S. National Plant Germplasm System.

Characteristics of Your Collections

36. Do you have responsibility for the preservation or maintenance of any ***Genus*** resources? *(Check one.)*

    1. ☐ Yes
    2. ☐ No. *(GO TO QUESTION 48)*

37. In general for how many years do you intend to preserve or maintain your genetic resources? *(Check one.)*

    1. ☐ Less than 1 year
    2. ☐ 1 to 10 years
    3. ☐ 11 to 20 years
    4. ☐ 21 to 30 years
    5. ☐ 31 to 40 years
    6. ☐ Over 40 years

38. Who owns the genetic resources you preserve or maintain? *(Check all that apply.)*

    1. ☐ College or University
    2. ☐ Private organization at which you work
    3. ☐ U.S. or state governmental organization or agency
    4. ☐ Governmental organization or agency of a country other than the United States
    5. ☐ Non-profit organization or agency
    6. ☐ Yourself
    7. ☐ Other (*specify*)

39. We would like to get some idea of the size of the ***Genus*** genetic resources collections you refer to in question 36, and the extent that material is distributed to others. About how many different accessions or samples of material do you have? What percent of those are duplicated at your facility, and what percent have been placed in long term back-up storage (e.g., at the National Seed Storage Laboratory)? Also, about how many accessions or samples of material, if any, have you sent to other scientists in the past 3 years? *Leave the spaces blank if you have no accessions in a category, and check no basis to judge if you do not have enough information to estimate numbers and percents.*

Categories of Genetic Resources	Accessions Preserved and Distributed: Total number of different accessions (1)	% of total accessions duplicated (2)	% of total accessions in back-up storage (3)	Number of accessions sent to others (4)	No basis to judge (5)
Gene pool 1					
1. Cultivars in current use		%	%		
2. Obsolete cultivars		%	%		
3. Traditional varieties (landraces)		%	%		
Gene pool 2					
4. Distant relatives of cultivated varieties that form fertile hybrids		%	%		
5. Biological species that can be crossed using conventional methods but with high level of sterility		%	%		
Gene pool 3					
6. Biological species that can be crossed only by use of advanced techniques		%	%		
Other					
7. Special genetic stocks		%	%		
8. Breeding derived samples		%	%		
9. Other (*specify*)		%	%		

40. If you can, please estimate the percent of existing diversity for ***Genus*** you believe is represented in the collection described in question 39? By existing diversity, we mean that which is represented in all cultivated and wild types world-wide. *(If you can't provide an estimate check no basis to judge)*

    1. _____Percent of existing diversity
    2. ☐ No basis to judge

41. Do you have unique accessions in your collection that would be of value to the U.S. National Plant Germplasm System? *(Check one.)*

    1. ☐ Yes
    2. ☐ Probably yes
    3. ☐ Undecided
    4. ☐ Probably no *(GO TO QUESTION 44)*
    5. ☐ No *(GO TO QUESTION 44)*

42. About how many of the possibly unique accessions were offered to the U.S. National Plant Germplasm System in the past 3 years; how many were accepted? *Estimate the numbers offered and accepted, or check no basis to judge.*

    1. _____ Number offered
    2. _____ Number accepted
    3. ☐ No basis to judge

43. If accessions were not accepted, why not? *(Check all that apply.)*

    1. ☐ All accessions were accepted
    2. ☐ Resources were duplicates
    3. ☐ Resources were thought to be in poor condition
    4. ☐ Recipient could not store or maintain
    5. ☐ Inadequate description
    6. ☐ Resources were not consistent with recipient's mission
    7. ☐ Other *(specify)*

       _____

    8. ☐ No reason given for non-acceptance

44. What percent of your ***Genus*** genetic resources are preserved or maintained in the following form(s)? (*Estimates are good enough*).

    Percent

    1. _____% Seed
    2. _____% Pollen
    3. _____% Clones/vegetative propagules
    4. _____% DNA (genetic sequences) library
    5. _____% In-vitro culture
    6. _____% Other *(specify)*

       _____

45. For genetic resources you preserve or maintain in any form, which of the following conditions, if any, are usually regulated and/or recorded? *(Check any conditions you regulate, and any for which records are kept).*

Types of Conditions	Regulate conditions (1)	Record conditions (2)
1. Temperature		
2. Relative humidity		
3. Packaging materials		
4. Spacing between plants (for clonal resources)		
5. Control of disease		
6. Atmosphere (e.g., C02)		
7. Control of insects/rodents		
8. Light quality and intensity		
9. Length of time in storage		
10. Other *(specify)*		

46. Which of the following maintenance activities, if any, do you usually perform? *(Check all that apply.)*

1. ☐ Germinate seed prior to placing it in storage
2. ☐ Conduct subsequent germination tests
3. ☐ Grow out seed to replenish collection(s)
4. ☐ Regenerate clonal resources
5. ☐ Test or treat for viruses and pathogens
6. ☐ None of the above

47. Which of the following standards for preservation, if any, do you apply in maintaining your genetic resources? *(Check all that apply.)*

1. ☐ No standards applied
2. ☐ International Board for Plant Genetic Resources (IBPGR) recommended standards
3. ☐ Standards used by , or recommended by the U.S. Department of Agriculture or National Seed Storage Laboratory
4. ☐ Standards established by the institution or industry with which you work
5. ☐ Your personal standards
6. ☐ Other *(specify)*

_____

48. To what extent, if at all, do you believe the following **preservation** activities should be **emphasized** to facilitate the overall management of ***Genus*** genetic resources? (*Check one column for each row to indicate the extent of **emphasis** or no basis to judge*).

Preservation Activities	Extent of Emphasis: Little or no extent (1)	Some extent (2)	Moderate extent (3)	Great extent (4)	Very great extent (5)	No basis to judge (6)
1. Developing new preservation techniques (e.g., tissue culture, cryopreservation, etc.)						
2. Increasing the size and/or improving the quality of existing storage facilities or clonal repositories						
3. Improving growout conditions or strategies						
4. Detecting and treating diseases and insects in storage						
5. Testing for and treating viruses, e.g., in clonal collections						
6. Developing core collections						
7. Improving access to collections						
8. Other (*specify*)						

DESCRIPTION OF *GENUS* GENETIC RESOURCES

This section provides information to genetic resource managers about the descriptions of stored genetic resources that are important to scientists who use the resources, and about the availability and usefulness of descriptive information.

49. Have you requested any type of descriptive information about ***Genus*** genetic resources, from any source or provider, within the past 5 years? *(Check one.)*

    1. ☐ Yes (*CONTINUE*)
    2. ☐ No (*CONTINUE*)

50. In instances when you have **not** requested descriptive information, which of the following reasons describe why not? *(Check all that apply.)*

    1. ☐ Descriptions of genetic resource accessions are not important to my work and are not needed (*GO TO QUESTION 53*)

    2. ☐ Do not believe information exists
    3. ☐ Information is difficult to obtain because of inaccessible data bases
    4. ☐ Believe existing information is not complete or accurate
    5. ☐ Believe information would not be relevant to current work
    6. ☐ Other (*specify*)_____

51. How important, if at all, are each of the following kinds of genetic resources information to your work? Also, indicate if accurate or complete information is hard to get, or if information is impossible to get. *(For level of importance check only one of the columns numbered 1-5 or no basis to judge for each row).*

Type of information	1-Level of importance: Little or no importance (1)	Some importance (2)	Moderate importance (3)	Great importance (4)	Very great importance (5)	No basis to judge (6)	2-Access: Impossible to get information (1)	Hard to get complete/accurate information (2)
1. Scientific name and/or taxonomic grouping								
2. Common name(s)								
3. Donor/collector								
4. Accurate location of collection site, altitude, latitude, longitude, etc.								
5. Conditions at collection site (e.g., climate, soil, pests)								
6. Pedigree/genetic history								
7. Health/viability								
8. Extent of expected diversity in each accession received								
9. Nutritional needs of plants								
10. Phenological traits (e.g., seed coat color or life cycle)								
11. Physical traits such as leaf size, growth habit, bud size and shape)								
12. Known genetic traits for resistance to disease, pests, or environmental stresses; mineral tolerance; yield; and adaptation, etc.								
13. Crossability with commercial cultivars								
14. Description of uses of commercial cultivars								
15. Human or animal nutritional information (e.g., protein level, oil content)								

52. Please list additional types of descriptive information that, if available, would assist you in your work.

_____

_____

_____

53. To what extent, if at all, do you believe the following **description** activities should be emphasized to facilitate the overall management of ***Genus*** plant genetic resources? *(Check one column for each activity listed.)*

Description of Activities	Extent of Emphasis: Little or no extent (1)	Some extent (2)	Moderate extent (3)	Great extent (4)	Very great extent (5)	No basis to judge (6)
1. Evaluating accessions for individual traits						
2. Mapping genes in stored accessions						
3. Eliminating unnecessary duplicate accessions						
4. Maintaining and updating a centralized database for users						
5. Providing descriptive information, including background, taxonomy, and pedigree data						
6. Other (*specify*)						

54. Consider your own research and breeding efforts during the past 3 years. For about how many accessions have you generated descriptive and/or evaluation information? *Estimates are good enough.*

_____ (Number of accessions) *(IF NONE, GO TO QUESTION 60)*

55. Is this descriptive and/or evaluation information recorded in any manner? *(Check one.)*

1. ☐ Yes *(CONTINUE)*
2. ☐ No *(GO TO QUESTION 60)*

56. Which of the following methods are used to retain/record this information? *(Check all that apply.)*

    1. ☐ Manual/mechanical files
    2. ☐ Computerized files
    3. ☐ Publications

57. To what extent, if at all, is this information organized, cross indexed, and labeled for ease of access? *(Place a check mark in the appropriate column.)*

	Little or no extent (1)	Some extent (2)	Moderate extent (3)	Great extent (4)	Very great extent (5)
1. Manual or mechanical					
2. Computerized					
3. Publication					

58. Is your manual or computerized information usually available to others? *(Check one.)*

    1. ☐ Yes
    2. ☐ Generally yes
    3. ☐ As often yes as no
    4. ☐ Generally no
    5. ☐ No

59. How long do you plan to retain your manual or computerized information? *(Check one.)*

    1. ☐ Less than 1 year
    2. ☐ 1 to 3 years
    3. ☐ 4 to 6 years
    4. ☐ 7 to 9 years
    5. ☐ More than 9 years

60. In general, over the past 3 years, in about what percent of the instances have providers (people who sent you ***Genus*** genetic resources) asked you to send back your evaluation data? *(Answer for both USDA/ARS as well as for other providers)*

    1. _____ % of USDA/ARS asking for evaluation data
    2. _____ % of others asking for evaluation data
    (IF BOTH ARE 0 %, GO TO QUESTION 63)

61. About how often, if at all, did you provide the requested data?

	% of instances you provided requested data				
Providers	10% or less (1)	About 25% (2)	About 50% (3)	About 75% (4)	About 90% or more (5)
1. USDA/ARS					
2. Other providers					

62. Which, if any, of the following reasons made it difficult for you to provide the requested information? *(Check all that apply.)*

1. ☐ All requested information was provided
2. ☐ Did not evaluate resources
3. ☐ No conclusive results were obtained
4. ☐ Primarily negative results were obtained from screening for specific traits
5. ☐ Information was proprietary
6. ☐ Not our policy to return information
7. ☐ Did not have time
8. ☐ Too Costly
9. ☐ Felt information was already readily available
10. ☐ Information was difficult to copy, extract, format or send
11. ☐ Other (*specify*)_____

_____

GENUS CROP IMPROVEMENT AND RESEARCH

This section provides a status of ongoing efforts involving the use of ***Genus*** genetic resources, including funding and staff levels, the primary focus of programs, and extent of use of genetic resources.

63. How many full-time equivalent staff does your entire organization, or do you personally have working on ***Genus*** breeding and/or research? (By full-time equivalent we mean the sum of all full-time and part-time staff hours converted to represent an equivalent number of full-time staff.) Also, aboutwhat percent of the total FTEs is dedicated primarily to each of the broad areas of emphasis listed below? (*Answer for your organization, your own area of responsibility, or both as appropriate for your situation. Percents should total 100.*)

63a. **Your Organization's Staff**_____(Total number of full-time equivalent employees)

Percent of FTEs	**Primary Emphasis**
1. _____%	Improving crops to enhance commercial values
2. _____%	Improving preservation techniques or conditions
3. _____%	Developing or improving genetic manipulation or other advanced (biotechnology) techniques
4. _____%	Basic research
5. _____%	Other (*specify*) _____
100%	Total
6. ☐	No basis to judge

63b. **Your Staff**_____(Total number of full-time equivalent employees)

Percent of FTEs	**Primary Emphasis**
1. _____%	Improving crops to enhance commercial values
2. _____%	Improving preservation techniques or conditions
3. _____%	Developing or improving genetic manipulation or other advanced (biotechnology) techniques
4. _____%	Basic research
5. _____%	Other (*specify*) _____
100%	Total
6. ☐	No basis to judge

64. Please estimate the total amount of funding that your organization or you have received for ***Genus*** breeding and/or research program(s) in the past 3 years. (*If your budget is aggregated to include other crops and uses please estimate how much went for* ***Genus***.)

    1. Organization's program $_____
    2. Your program $_____
    3. ☐ No basis to judge (*GO TO QUESTION 66*)

65. Approximately what percent of this funding was provided by the following sources? *(Fill in the blanks with the appropriate percents for your organization and/or your area of responsibility, as appropriate. Percents should total 100. If you don't have access to this information, check no basis to judge.)*

Percent of Funding		
1-Organization's Program	**2-Your Program**	**Source of Funding**
01. _____%	_____%	International sources (e.g., FAO, IBPGR.)
02. _____%	_____%	Government sources in countries other than the USA
03. _____%	_____%	USDA/CSRS competitive grants
04. _____%	_____%	All other USDA funds
05. _____%	_____%	Other federal agencies (e.g., U.S. AID)
06. _____%	_____%	State agencies/State Experiment Stations
07. _____%	_____%	Universities
08. _____%	_____%	Foundation Seed Royalty Associations/Crop Improvement Foundations
09. _____%	_____%	Private industry
10. _____%	_____%	Private foundations (e.g., Rockefeller Foundation, Ford Foundation, etc.)
11. _____%	_____%	Crop specific associations
12. _____%	_____%	User or membership fees
13. _____%	_____%	Other (*specify*) _____
100%	100%	Total
14. ☐	No basis to judge	

29

66. Please indicate the extent, if at all, your ***Genus*** breeding and/or research efforts currently emphasize the following objectives. Also, indicate the extent, if at all, you believe your efforts will be directed toward these objectives in the next three years. (*Check one column for each heading*)

Breeding/Research Objectives	1-Extent of current emphasis: Little or no extent (1)	Some extent (2)	Moderate extent (3)	Great extent (4)	Very great extent (5)	2-Extent of emphasis in next 3 years: Little or no extent (1)	Some extent (2)	Moderate extent (3)	Great extent (4)	Very great extent (5)
Commercial emphasis										
1. Increasing yields or production										
2. Enhancing nutritional values of crops										
3. Expanding commercial uses of crops										
4. Improving product processing or storage techniques										
Search for resistance										
5. Identifying traits for resistance to known diseases, pests, etc., that have not yet been found in genetic resources for this crop										
6. Identifying traits for greater adaptation to environmental or physical stresses										
Preservation emphasis										
7. Improving storage techniques for maintaining genetic resources										
8. Identification and control of pests, pathogens, viruses, or other deterioration in stored accessions										
9. Evaluating gene bank accessions										
Other research										
10. Mapping genes not yet identified with any known traits										
11. Identifying new sources of genetic variation within or outside the genus										
12. Studying population genetics										
13. Study of host plant/parasite interaction										
14. Improving genetic manipulation (biotechnology) techniques for breeding and/or research										
15. Other research (*specify*)										

67. Please indicate the extent, if at all, each of the following reasons influenced decisions to develop, conduct and/or participate in your current breeding and/or research programs? (*Check one column for each row*)

Reasons for Breeding or Research Programs	Extent reasons influenced decisions: Little or no extent (1)	Some extent (2)	Moderate extent (3)	Great extent (4)	Very great extent (5)	No basis to judge (6)
1. High economic value of crop						
2. Environmental stresses are endangering crops						
3. Changes in land use patterns						
4. Pests or diseases are endangering crops						
5. Required by funding source or research leader						
6. Scientific interest/discovery						
7. Current and/or potential demand for hybrids						
8. Production of cultivars						
9. Amount of domestic consumption						
10. Demand for export to other countries						
11. Current and potential number of uses for the crop (e.g., food, fiber, forage, fuel)						
12. Pressure from the crop producer or end user groups						
13. Increased use of alternative farming products						
14. Low input sustainable agriculture (LISA)						
15. Other (*specify*)						

68. About how many different accessions, samples, etc. are you currently using in your breeding or research efforts? About how many do you plan to use in the next 3 years? Please estimate these numbers for each of the genetic resource categories. *(If none, enter 0).*

Categories of Genetic Resources	Current Use	Use in next 3 Years
Gene pool 1		
1. Cultivars in current use		
2. Obsolete cultivars		
3. Traditional varieties (landraces)		
Gene pool 2		
4. Distant relatives of cultivated varieties that form fertile hybrids		
5. Biological species that can be crossed using conventional methods but with high level of sterility		
Gene pool 3		
6. Biological species that can be crossed only by use of advanced techniques		
Other		
7. Special genetic stocks		
8. Breeding populations		
9. Other (*specify*)		

69. Are you currently searching for traits for resistance to specific stresses (e.g., specific disease, pest, etc.) in ***Genus***? *(Check one.)*

1. ☐ Yes *(CONTINUE)*
2. ☐ No *(GO TO QUESTION 72)*

70. Please indicate specific resistance traits for which you are searching or check information is proprietary.

1. _____
_____
_____
_____

2. ☐ Information is proprietary

71. Were the traits or descriptors you searched for recommended by a major advisory organization such as a U.S. Crop Advisory Committee, the International Board for Plant Genetic Resources, etc.? *(Check one.)*

1. ☐ No
2. ☐ Yes
3. ☐ Proprietary information
4. ☐ No basis to judge

72. We would like to know to what extent, if at all, you believe the descriptors for resistance recommended by major advisory organizations include the traits that you believe should be research priorities? *(Check one.)*

1. ☐ To little or no extent
2. ☐ To some extent
3. ☐ To a moderate extent
4. ☐ To a great extent
5. ☐ To a very great extent

_____

6. ☐ No basis to judge

73. What, if any, specific **resistance** traits do you believe need greater emphasis as research priorities. (*Write none if none, or check information is proprietary.*)

1. _____

_____

_____

_____

2. ☐ Information is proprietary

74. To what extent, if at all, do you believe the following research, crop improvement, or enhancement activities should be emphasized to facilitate the overall management of ***Genus*** plant genetic resources? (*Check one column for each activity*).

Activity	Extent of emphasis: Little or no extent (1)	Some extent (2)	Moderate extent (3)	Great extent (4)	Very great extent (5)	No basis to judge (6)
1. Identifying and mapping genes						
2. Developing resistance to stresses (environmental, diseases, insects, pesticides, etc.)						
3. Identifying traits for, and/or improving commercial qualities of crops						
4. Improving or developing advanced (biotechnology) techniques, such as molecular genetics, cell tissue culture, gene mapping, etc.						
5. Transferring characteristics from non-adapted genetic resources to adapted types (pre-breeding, enhancement)						
6. Developing new uses for undomesticated genetic resources						
7. Other (*specify*) _____						

Impact of Advanced (Biotechnology) Techniques on Breeding and Research

75. **During the past 5 years,** have you used any advanced (biotechnology) techniques in your breeding or research programs where ***Genus*** genetic resources were involved? *(Check one.)*

1. ☐ Yes *(CONTINUE)*
2. ☐ No *(GO TO QUESTION 80 AND THE DEFINITIONS ON PAGE 37).*

76. **Please indicate the extent, if at all, you have used the following advanced (biotechnology) techniques during the past 5 years. Also, indicate the extent, if at all, the use of each technique has changed the emphasis or objectives of your breeding or research efforts up to the present time.** *(Check one column under each heading for each row).*

Techniques Used	1-Extent technique used in past 5 years: Little or no extent (1)	Some extent (2)	Moderate extent (3)	Great extent (4)	Very great extent (5)	2-Extent use of technique changed emphasis: Little or no extent (1)	Some extent (2)	Moderate extent (3)	Great extent (4)	Very great extent (5)	No basis to judge (6)
1. Gene mapping through RFLPs, molecular markers, or isozymes											
2. Cell or tissue culture											
3. Methods to achieve DNA gene transfer											
4. Site directed mutagenesis											
5. Chemical synthesis of nucleic acids or gene synthesis											
6. Protoplast fusion											
7. Widecrosses											
8. Other *(specify)*											

77. Please indicate the extent, if at all, you expect the advanced (biotechnology) techniques to change the emphasis or objectives of your breeding and/or research efforts in the foreseeable future. *(Check one column under each heading for each row.)*

Techniques used	Expected change in breeding or research emphasis: Little or no extent (1)	Some extent (2)	Moderate extent (3)	Great extent (4)	Very great extent (5)	No basis to judge (6)
1. Gene mapping through RFLPs, molecular markers, or isozymes						
2. Cell or tissue culture						
3. Methods to achieve DNA gene transfer						
4. Site directed mutagenesis						
5. Chemical synthesis of nucleic acids or gene synthesis						
6. Protoplast fusion						
7. Widecrosses						
8. Other *(specify)*						

78. Is the use of these advanced techniques changing, to any extent, the amount or types of genetic resources you use in your breeding or research efforts? *(Check one.)*

1. ☐ Yes*(CONTINUE)*
2. ☐ No *(GO TO QUESTION 80 AND THE DEFINITIONS ON PAGE 37)*

79. Indicate whether use of advanced (biotechnology) techniques is causing an increase, decrease, or no change in your use of genetic resources in each category. (*Check one column for each row.*)

Categories of Genetic Resources	Change in Use: Increase (1)	Decrease (2)	No change (3)
Gene pool 1			
1. Cultivars in current use			
2. Obsolete cultivars			
3. Traditional varieties (landraces)			
Gene pool 2			
4. Distant relatives of cultivated varieties that form fertile hybrids			
5. Biological spicies that can be crossed using conventional methods but with high level of sterility			
Gene pool 3			
6. Biological species that can be crossed only by use of advanced techniques			
Other			
7. Special genetic stocks			
8. Breeding populations			
9. Other (*specify*)			

DEFINITIONS OF PLANT GENETIC RESOURCE MANAGEMENT ACTIVITIES

We want to know if opinions about placing emphasis on particular genetic resource activities, provided by scientists who use the resources, can help genetic resource managers identify differences in needs among crops or genera. **Please familiarize yourself with the following definitions before continuing to question 80.**

ACQUISITION: Collecting additional plant genetic resources from centers of diversity and other world locations, as well as through exchange with other scientists or genebanks.

PRESERVATION - Storing and maintaining plant genetic resources in genebank institutions throughout the world in order to assure that (1) a diverse supply of plant genetic resources is available to breeders and researchers, and (2) sufficient diversity exists in genebanks to assure the long-term survival of cultivated crop species.

DESCRIPTION - Identifying and accurately describing plant genetic resources (especially those stored in collections throughout the world) by developing accurate passport documentation and evaluating for descriptors.

ENHANCEMENT - Transferring characteristics from non-adapted genetic resources to adapted types (pre-breeding) so that scientists can more easily use the characteristics to improve cultivated crops.

BREEDING - Developing new plant varieties or improving existing varieties (especially commercial crops) using traditional methods of crossing varieties (i.e. not using modern molecular genetics technologies to transfer genes from one variety to another).

BIOTECHNOLOGY - Developing and applying advanced techniques to identify and manipulate genes, or improve storage technologies for plant genetic resources.

80. Based on your knowledge and experience, please rate the relative importance of emphasizing the major activities, defined above, to the overall improvement of ***Genus*** genetic resource preservation and use. Do this by considering each pair combination of the six major activities listed in the fifteen rows below. On each row, please compare the two activities designated Activity A and Activity B (e.g., description | preservation). Please note that nine columns are arranged so that you may check one column for each row to indicate which activity is more important, or that they are equal in importance. We realize that some choices may be easy while others may be very difficult. But regardless, be sure to rate each combination pair because we cannot make an accurate assessment unless all 15 pairs are rated.

*Please check the middle column (5) if you believe the two activities should be emphasized equally for the overall improvement of **Genus** genetic resource management. If you believe Activity A is more important than Activity B, check one of the columns to the left of center to indicate how much more important A is over B, or if you believe Activity B is more important than Activity A, check one of the columns to the right of center to indicate how much more important B is over A.*

	Relative Importance of One Activity Over the Other								
Activity A | Activity B	Evidence affirms importance of "A over B" (1)	Practice demonstrates importance of "A over B" (2)	Experience strongly favors "A over B" (3)	Experience weakly favors "A over B" (4)	"A and B" are equally important (5)	Experience weakly favors "B over A" (6)	Experience strongly favors "B over A" (7)	Practice demonstrates importance of "B over A" (8)	Evidence affirms importance of "B over A" (9)
1. Biotechnology | Acquisition									
2. Description | Breeding									
3. Enhancement | Preservation									
4. Acquisition | Description									
5. Preservation | Biotechnology									
6. Breeding | Enhancement									
7. Biotechnology | Breeding									
8. Description | Preservation									
9. Enhancement | Acquisition									
10. Acquisition | Breeding									
11. Preservation | Acquisition									
12. Breeding | Preservation									
13. Biotechnology | Enhancement									
14. Description | Biotechnology									
15. Enhancement | Description									

81. If you have any comments or qualifications on any of the questions asked or on any questions we should have asked but did not, please make these statements in the space below. We would like to hear from you. (*Attach additional sheets if necessary*)

82. In order for us to discuss the questionnaire with you and to follow-up on responses, if necessary, please provide the following information:

Your telephone number:_____

Best day of the week for us to call you:

_____

Best time of the day for us to call you:

_____

83. To assist us with further development of questionnaire respondent lists, please provide the names and addresses of up to three users of ***Genus*** genetic resources, who do work similar to your own.

_____

_____

_____

_____

_____

_____

_____

_____

_____

Thank you.

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