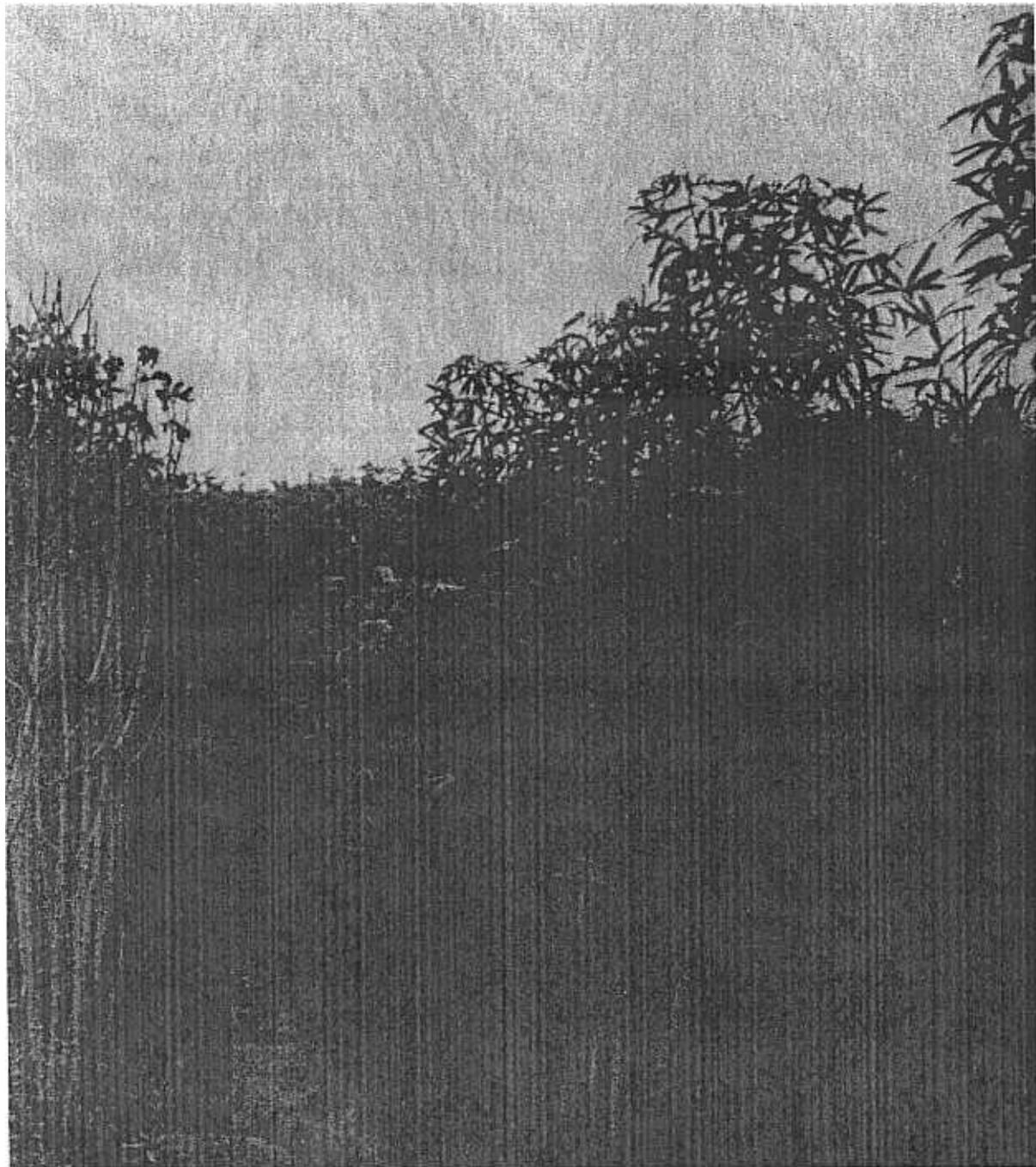




Management of field and *in vitro* germplasm collections

Proceedings of a consultation meeting - 15-20 January 1996 CIAT, Cali, Colombia

Florent Engelmann, editor



Establishment and operation of a temperate clonal field genebank

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Introduction

After more than 12 years of planning and congressional lobbying by researchers and growers, an appropriation of US\$2 million was provided in 1979 to the US Department of Agriculture, Agricultural Research Service (USDA-ARS), which established eight field genebanks. These genebanks, called 'Clonal Germplasm Repositories', were added to the four seed genebanks, i.e. the Regional Plant Introduction Stations, which were established in 1946 (Shands 1995) as the working collections of the US National Plant Germplasm System (NPGS). The USDA-ARS National Clonal Germplasm Repository at Corvallis, Oregon, dedicated in 1981, was the first of the clonal field genebanks to be opened. Since then, seven additional banks have been established. This paper will describe the Corvallis Repository, with additional suggestions derived from observations of the NPGS during the past 15 years.

Administrative organization

Clonal field genebank operation is most effective with an assignment of multiple, but not an overwhelming number, of crops. Judging from facilities in the US system, 10 crops or related genera of major economic importance to the host country is reasonable. The staffing of such small service/research stations should include 10–15 permanent positions and about as many part-time seasonal, temporary or student aides. This allows for a total quality management-team approach to face the issues at hand.

Personnel

The Corvallis Repository has a staff of 12 permanent employees (including two scientists, one support scientist, three administrative support positions and six biological technicians) and 15 part-time aides. This size of unit leads to an excellent working and discussion group (Hummer 1995).

The Director and Curator assignments are combined into one position. The Plant Physiologist and Plant Pathologist provide critical professional input at a scientific level. A programme assistant keeps accounting and personnel details in order as well as having responsibilities for reception and meeting organization. A facilities maintenance person oversees the physical plant operations. A computer specialist maintains the essential and increasingly important world-accessible database.

Biological technicians provide daily maintenance of the plant collections including irrigation, integrated pest management, tissue culture and plant distribution. The part-time aides include visiting scientists, graduate and undergraduate students each of whom have advanced practical research experience in technical issues of genebank operation and who assist with plant evaluation; and seasonal aides who perform details such as plant labelling, pruning, trellising and harvesting.

Facilities

The facilities at the Corvallis Repository include 929 m² main office and laboratory space, 929 m² greenhouses, 1800 m² screenhouses, two walk-in refrigerated units at 4°C with no humidity control, and 26 ha of land for field plantings (Hummer 1995).

This property is presently adequate in size to preserve the genetic diversity assigned to the Corvallis Repository. Since the 10th anniversary of the building, the facilities repair and maintenance has been costing about 8% of base funding per annum; 4% of this is provided annually from unit funds, with an additional 4% coming from administrative agency funding.

Strategies in germplasm preservation

Numbers

Major crops or genera with broad diversity and world distribution should be represented by 1000 accessions upon collection maturity. Initially the collection may be larger because multiple sources of the same-named clone may be obtained to insure that one specific, correctly identified genotype is present. After evaluation, duplicate or incorrect accessions are eliminated. The main assignment at Corvallis is to store specific genotypes. Some species diversity (about 25% of the collection) is represented by the storage of orthodox seed.

Plant exploration

Since 1987, ten USDA-sponsored plant exploration expeditions were sent to collect small fruits (Williams 1995). The total trip costs of more than US\$100 000 resulted in nearly 1000 new acquisitions, combining what was initially received with additional materials sent later by trip collaborators. We thus estimate major exploration costs to be US\$100 per accession. As of 1995, the Corvallis Repository has received about 12% of the collection through major plant exploration trips, about 12% from locally funded exploration, and about 75% through germplasm exchange. Present gaps in the collection are primarily in wild material, so the exploration percentages should increase over time.

Preservation

Primary collection

Ideally, three correctly identified, pathogen-negative plants per accession should be maintained in a primary collection. This allows for statistical evaluations. These replicates should be planted adjacent to each other, because identity confirmation needs outweigh those of statistical randomness. The primary collections should be tested for germplasm-borne pathogens. Infected accessions should be replaced with pathogen-negative germplasm where possible. Presently about 70% of the clones at the Corvallis Repository are pathogen-tested. These are freely available for distribution to researchers around the world.

Integrated pest management approaches, including monitoring of pests, timely application of biological controls, pheromones, clean cultural practices and minimal use of 'softer' pesticides, ensure that healthy plants are used at the Repository. These strategies promote environmental safety, minimize employee exposure, and allow for evaluation of disease resistance.

Secondary and base collections

A secondary or back-up collection such as *in vitro* cold storage, or cryogenic preservation of meristems or buds, should be established on site or at a remote site. The Corvallis Repository has established about 1500 tissue-cultured accessions of *Fragaria*, *Mentha*, *Pyrus*, *Ribes* and *Rubus* in mid-term storage, and is working with the National Seed Storage Laboratory at Fort Collins, Colorado for long-term cryogenic preservation of *Mentha*, *Pyrus* and *Ribes* (see Reed, this volume).

Costs

The NPGS collaborates with state universities for mutual benefit. At many locations land for the buildings and collections, some professional and manual labour, and security, library, computer and other services are provided by the state university. At the Corvallis Repository about 10 ha of land with water rights and associated services are provided by Oregon State University.

The following estimates are based on present costs incurred for the preservation of temperate fruit and nut crops at the Corvallis Repository. The cost of field, greenhouse, screenhouse, testing, information maintenance, distribution and administration is estimated to be US\$77 per accession per year; secondary on-site tissue culture back-up is roughly US\$23 per accession

per year; total of US\$100 per accession per year. Remote long-term back-up in base collections is strongly recommended but requires additional funding estimated at an initial start-up cost of US\$50–65 per accession and annual cryogenic maintenance cost of about \$1 per year (Roos, pers. comm.).

Distribution

The Corvallis Repository has distributed about 13 000 accessions to 49 countries over the past 5 years. This distribution requires about 0.1 full-time equivalent curatorial responsibility and a full-time technical assistant. The most frequently requested type of germplasm was tissue culture, followed by seed, plant, scionwood and cuttings. Considering that the Repository distributes temperate rather than tropical fruit and nut genera, the foreign countries which requested the most germplasm from Corvallis during the past 5 years were Canada, Italy, China, Russian Federation and Australia. The Repository, along with the NPGS, considers that germplasm exchange is essential for crop improvement; that germplasm should be freely exchanged; that information about germplasm should be available with its distribution; and that a multilateral approach to free germplasm exchange is desirable (Shands 1995). The Corvallis Repository has more than 100 accessions which have been acquired through agreements involving intellectual property rights (IPR). These accessions are flagged in the database. Requesters must complete material transfer agreements or obtain permission of the IPR owner before these clonal plant materials can be distributed.

Economics

Unfortunately, present US federally funded plant genetic resource budgets are about 75% of adequate amounts, and are predicted to decline several percentage points for each of the next 5 years. Genebank directors and curators have adopted reduction strategies such as preserving fewer replicates in the primary collections, decreasing on-site or remote back-up accessions, or limiting acquisitions. These strategies should be carefully chosen to minimize the vulnerability of diverse plant genetic resources. The Corvallis Repository is reducing replicates in the primary collection but remains active in receiving critically needed new acquisitions. Core subsets, rather than complete collections, are being backed up in short-term refrigerated tissue-culture storage. Fewer research and evaluation projects are being initiated. Additional extramural funding is being sought for Repository operations. In this time of federal downsizing, appropriations for base funds are being reduced and money to initiate new federal projects is almost non-existent. The challenges and opportunities are great for the future of genetic resource conservation.

References

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