CIP's Research Project Portfolio

Project 1

Integrated control of late blight

(R. Nelson (until December 2000) / J. Landeo)

CIP's highest research priority is to develop, adapt, and integrate technologies for managing late blight of potato, the world's worst agricultural crop disease, caused by the oomycete *Phytophthora infestans*. CIP scientists use a range of methods, including state-of-the-art biotechnological tools, to produce breeding populations and advanced clones with durable resistance to the disease. Additional component technologies are being developed for integrated disease management under the conditions encountered by resource-poor farmers in developing countries. Geographic information systems are linked with crop and disease models to understand the complexities of the disease's epidemiology across diverse agroecosystems.

Project 2

Integrated control of bacterial wilt

(S. Priou)

Bacterial wilt (BW), caused by *Ralstonia solanacearum*, is the second main potato disease in the world. The key to overcoming the constraint is to control the spread of the disease by using only healthy planting material. CIP's research therefore concentrates on developing tools to detect the presence of bacteria in soil and tubers. This knowledge is used to improve crop management and seed systems and to identify available resistant/tolerant material. The project also aims at designing, validating, and promoting integrated strategies for managing bacterial wilt in different production systems and completing the selection of potato progenies with tolerance or resistance to BW developed in past years. Main components for BW management are seed health, plant resistance, crop rotation, soil fertility, and biological control.

Project 3

Control of potato viruses

(L. Salazar)

Virus diseases cause serious losses in potato and also disrupt global efforts to improve potato, because national and inter-national regulations control the movement of virus-infected seed and genetic resources. Biotechnology tools are used to identify resistance genes in related plant species and to clone and transfer them to potato; these tools are combined with traditional methods of breeding to develop adapted cultivars resistant to a range of viruses. Identifying and characterizing the most important viruses and virus-like agents that affect potato are essential steps toward developing sensitive, low-cost methods for large-scale detection. CIP researchers also study epidemiological factors that affect virus spread, with particular attention to interaction between viruses and other pathogens that may affect plant resistance response, and train national scientists in virus identification, detection, and control techniques. Research and training activities focus on the most important potato viruses (PLRV and PVY) and on the potato spindle tuber viroid (PSTVd). Particular attention is given to practical utilization/ adoption of virus-resistant materials already produced at CIP (including genotypes already carrying combined resistance to more than one virus, preferably in a multiplex condition).

Project 4

Integrated management of potato pests (A. Lagnaoui)

Key pests of potato, globally or regionally, are three species of potato tuber moth (a threat that is rapidly becoming more serious), several species of Andean potato weevil, the leaf-miner fly, whiteflies and several flea beetles. Nematodes that reduce potato yields and favor the development of bacterial wilt pathogens are potato cyst, rosary, and root-knot nematodes. This project seeks to develop locally-adapted integrated pest management programs for these pests, emphasizing sustainable, ecologically-based, and economically-sound practices that will lead to reduced use of chemical pesticides and increased benefits for farmers. Components include biological, cultural, and resistance aspects of control.

Project 5

Propagation of clonal potato planting materials (U. Jayasinghe (until June 2000) / M. Bonierbale)

In many countries, the lack of efficient formal and informal seed potato systems has limited the diffusion of new and improved varieties because only limited amounts of healthy clonal planting material are available. Varietal introduction and diffusion is dependent on the informal system, but it must be linked with the formal system and it must emphasize high quality planting material. This project provides research and technical assistance to selected formal and informal seed systems in various countries to help them improve their efficiency and effectiveness. This is accomplished through farmer training and establishment of pilot seed systems. The project also explores innovations in linkages between formal and informal seed systems, aiming to speed up varietal introduction and diffusion.

Project 6

Sexual potato propagation (TPS) (M. Upadhya (until June 2000) / E. Chujoy)

True potato seed (TPS) enables a crop to be grown in areas where traditional production systems fail, for example, where seed tubers are scarce or not available. By facilitating the transfer of TPS technology in such areas of the tropics and subtropics, this project aims to expand potato cultivation and increase its efficiency (reduce production costs, increase yields). CIP concentrates on improving parents for hybrid TPS production and developing needed specific traits such as late-blight resistance, earliness, and seed set. CIP's work is backstopped by local organizations (private sector, NGOs, NARS) in efforts to commercialize TPS systems and thus underpin developing small industries.

Project 7

Global sector commodity analysis and impact assessment for potato and sweetpotato (T. Walker)

The objective of this project is to provide more complete information to scientists, research administrators, policy-makers, and donors for decision-making on technology design, resource allocation, policy formulation, and investment options related to potato and sweetpotato improvement and utilization. Some of the specific objectives are to: quantify the agronomic, economic, social and environmental effects of improved potato and sweetpotato technologies; document the rate of return and the effect on poverty of CIP's research; assess the level and adequacy of investment in potato and sweetpotato crop improvement in developing countries; assemble and maintain price and production databases for priority setting; evaluate the effects of potato price instability on diverse groups in society; assist in improving domestic potato and

sweetpotato marketing and international potato trade benefiting developing countries; and participate in generating the most informative commodity projections with specialized institutions.

Project 8

Control of sweetpotato viruses
(L. Salazar)

Virus diseases greatly reduce sweetpotato yields worldwide, particularly in Sub-Saharan Africa. Control can be achieved by using healthy planting materials (the use of virus-free planting materials alone can triple yields) and developing resistant cultivars. Identification of viruses and development of sensitive methods of detection are fundamental steps toward this end. Previous work has shown that a synergy between sweetpotato feathery mottle virus (SPFMV) and sweetpotato chlorotic stunt virus (SPCSV) causes the sweetpotato virus disease (SPVD) that can devastate crops. The project aims to identify the viruses causing major losses in production, develop methods of detection, and apply methods of control. Researchers seek to develop resistance to SPVD using a range of breeding approaches, including the most advanced molecular methods.

Project 9

Integrated management of sweetpotato pests (E. van de Fliert)

The aim of this project is to develop IPM (integrated pest management) systems for sweetpotato. These systems need to be compatible with farmers' crop management practices, as well as with prevailing ecological and socioeconomic conditions, to ensure effective and sustainable solutions. Therefore, participatory approaches are applied to prioritize research needs, develop adapted pest and crop management components, and design learning strategies which enhance farmers' ecological knowledge and decision-making and problem-solving skills. IPM training programs are designed, and their implementation by governmental and nongovernmental organizations facilitated, through the training of trainers and provision of sweetpotato IPM information materials.

Project 10

Postharvest utilization of sweetpotato
(G. Scott (until August 2000)/D.P. Zhang)

This project studies technologies to improve the livelihoods of rural poor through diversification and expansion of sweetpotato use. The main beneficiaries are women and children and small households. Nutrition and income are improved and poverty is reduced. Project goals include facilitating the development of small enterprises based on added-value from primary processing (e.g., starch and flour), and the more efficient use of sweetpotato roots, vines, and by-products as animal feed. In Africa, the goal is to enhance food security by taking advantage of sweetpotato's nutritional qualities. CIP researchers evaluate opportunities and undertake collaborative research on markets, raw material quality, process development, product quality, and the social acceptability of innovation in pilot enterprises. They tap such resources as NARS, NGOs and users in target countries, along with global centers of research excellence in disciplines not available in-house, such as food science/technology and animal sciences.

Project 11

Breeding sweetpotato for high-dry-matter yield and adaptation (D.P. Zhang)

This project aims to improve sweetpotato production and use through the development and adoption of high-dry-matter/high-starch varieties with adaptability to low-input, subsistence farming systems. The diverse sweetpotato germplasm at CIP

is used to generate high-dry-matter parental clones through population breeding. A well established, decentralized breeding framework uses these advanced parental clones to produce new varieties with a broader genetic background and good adaptability to cope with abiotic and biotic stresses in target environments. Molecular approaches are applied to develop, expand and efficiently use the genetic variations in order to meet breeding needs. The new clones are being adapted to low-input subsistence systems in target environments to feed into the developing markets. The project therefore provides the raw material for increase in the use of both fresh and processed sweetpotato. Dry matter is the essential component in both types of use.

Project 12

Strategic Initiative on Urban and Peri-urban Agriculture (G. Prain)

The Strategic Initiative on Urban and Peri-urban Agriculture (SIUPA) was launched by the CGIAR in late 1999 in response to growing urbanization and increased dependence of city dwellers on farming: CIP is the convening center for the initiative. SIUPA's goals are to contribute to increased food security, improved nutritional status, and higher incomes of urban and peri-urban farmers; reduce the negative environmental impact of urban and peri-urban agriculture and enhance its positive ecological potential; and establish the perception of urban and peri-urban agriculture as a positive, productive, and essential component of sustainable cities. In collaboration with the many national and international efforts that have started in recent years to address the issue of urban and peri-urban agriculture, SIUPA is establishing, in regional sites, a set of research activities collectively known as Urban Harvest. Several international agricultural research centers are already working in such areas as technology and policy aspects of urban agriculture and nutrition, enhanced efficiency and sustainability of peri-urban vegetable production systems, health impacts of the use of urban waste water in agriculture, and the development of sustainable peri-urban agro-processing and livestock enterprises.

Project 13

Sustainability of rice-based cropping systems featuring potato as a cash crop (T. Walker)

In response to increasing land scarcity in subtropical South and Southeast Asia, potatoes with a high production potential per unit time are increasingly being planted in intensive sequential cropping systems, such as rice–potato–rice, and in more intensive intercrops, such as rice–potato/maize. Typically, rice is planted at the onset of the rainy season, irrigated potato is sown in the cooler dry season, and irrigated rice or another crop is cultivated in the hot summer. To realize the potential of the potato crop, factors that threaten the sustainability of these input-responsive cropping systems must be identified and addressed. This project diagnoses constraints to increasing and maintaining productivity in selected potato and rice-based cropping systems; and generates crop and natural resource management information on how to alleviate the most important of those constraints.

Project 14

Sustainable land use in the Andes (R. Quiroz)

The Andes comprises a series of unique habitats rich in natural resources. The inhabitants of this region confront massive poverty, increasing population growth, and rapid degradation of the natural resource base. They face the difficult challenge of trying to increase agricultural productivity while simultaneously decreasing stress on

the environment. This project aims to characterize the Andean ecoregion for its potential for sustainable agriculture, and to provide a scientific, technical, and economic base for policy and technology recommendations to decision-makers in the region. It also seeks to develop innovative methodologies for ecoregional research through an effective integration of process-based crop growth models, remote sensing, economic decision models, and geographic information systems. Through short-term training and collaborative research, the project aims to build an international community of researchers working toward sustainable development of agriculture in mountain areas.

Project 15

Conservation and characterization of potato genetic resources
(Z. Huamán (until June 2000)/W. Roca

CIP holds the most comprehensive collection of germplasm of wild and cultivated potatoes in the world. Key objectives of this project include safe, long-term conservation and characterization of the germplasm, and developing a database containing all information on the collection and making this information available to interested parties. Research attempts to increase utilization of the potato genetic diversity by identifying key desirable traits and distributing healthy seed stocks and clonal materials throughout the world for use in potato improvement programs. The project provides key input into CIP's own breeding efforts.

Project 16

Conservation and characterization of sweetpotato genetic resources
(M. Hermann)

The overall objective of this project is to safeguard sweetpotato genetic resources and to facilitate their use for the benefit of resource-poor sweetpotato producers and users. Specifically, it seeks to develop cost-efficient and sustainable conservation methods, to contribute to the understanding of biogeographic and genetic patterns of diversity, and to document and disseminate traditional and technical knowledge on sweetpotato genetic resources worldwide. Expected impacts include the enhanced use of germplasm in breeding and varietal testing, improved international task and resource sharing for sweetpotato conservation, and reduced genetic redundancy of sweetpotato holdings.

Project 17

Conservation and characterization of Andean root and tuber crops (M. Holle)

Assisting national programs in rationalizing strategies for both ex situ and in situ conservation of Andean root and tuber crops (ARTC) involves the study and preservation of biodiversity, with emphasis on four priority genera – *Oxalis* (oca), *Ullucus* (ulluco), *Canna* (achira), and *Arracacia* (arracacha), including wild species—and on the material of *Mirabilis expansa* (mauka), *Pachyrhizus ahipa* (ahipa), *Smallanthus sonchifolius* (yacon), *Tropaeolum tuberosum* (mashua), and *Lepidium* spp (maca). The project is systematically assessing the potential of ARTC to promote wider use in the subtropical and tropical highlands, within and outside the Andean region, through the study of current marketing and consumption patterns. It aims to identify latent demands these crops may satisfy in the future, and to produce healthy planting materials for farmers. This project is perhaps the only one in the world with a major effort towards developing virus identification and eradication procedures for these important, underutilized crops.