Research support services

ANALYTICAL SERVICE LABORATORIES

The Analytical Service Laboratories (ASL) provides routine analytical and analysis-related services to IRRI research programs and special projects. ASL completed 36,723 routine analyses (Table 1). More than 500 samples for multi-element analysis were not done due to the institute's inability to purchase nitric acid during the last quarter of the year.

Training

Training in safe handling of radioisotopes, particularly ^{32}P, ^{33}P, and ^{14}C, was given for 13 scholars and staff members from the Molecular Biology Laboratory, the Tissue Culture Laboratory, the Gene Mapping Laboratory, and Plant Physiology. The 5-day course included review of the principles of radioactivity and radioactive decay, biological effects of radiation, basic principles and concept of radiation protection, and radiation detection instruments. Environmental considerations in the use of radioisotopes, radioisotope handling procedures and safe transport, contamination and decontamination, waste management, and licensing procedures were also covered.

Practical liquid chromatography training was given for IRRI researchers and scholars who needed to apply liquid chromatography in their research work but lacked background and training to operate high-performance liquid chromatography (HPLC). The course covered separation and equipment basics, method development, practical and important considerations, and hands-on work suited to the participant's need. HPLC will be used to develop procedures for the determination of amino acids, phenolics and other aromatic compounds, cytokinin, sugar phosphates, photosynthetic pigments such as carotenoids, and vitamin A.

User Laboratory

ASL continued to provide liaison services with the Philippine Nuclear Research Institute for researchers using radiotracers in their work. Research on ion diffusion in flooded soil using ^{36}Cl was conducted in the radioisotope laboratory facilities in the Hemmi Building. The balance of radiotracer work was done in several IRRI laboratories—Gene Mapping Laboratory, Tissue Culture Laboratory, and Molecular Biology Laboratory.

Table 1. Analyses completed by ASL for IRRI programs during 2000.

Service	Program served (no. of analyses)							
	Training	Irrigated	Rainfed	Upland	Flood-prone	Cross ecosystems	Accelerating impact	Other
Plant analysis	26	7,809	2,751	6,262	0	899	2,236	5,892
Soil analysis	411	2,469	542	85	26	25	243	472
Water analysis	270	5	243	7	2	5		72
Mass spectrometry	136	621		28		60	7	545
Radioisotope counting	1,971	115						1,971
Total	2,814	11,019	3,536	6,382	28	989	3,003	8,952

Organic Analysis Laboratory

Two projects made use of the Organic Analysis Laboratory.

Analysis of soil organic matter. Previous investigations on sustainability of intensive lowland rice cropping have demonstrated that a primary change in soil properties occurring during intensive cropping has been an accumulation of phenolic compounds in soil organic matter. Because phenols stabilize N, their accumulation in soil represents a plausible explanation for the decrease in availability of organic bound N that has been associated with long-term intensive cropping.

Tetramethylammonium hydroxide (TMAH) thermochemolysis complements the previously reported pyrolysis-gas chromatography (GC)-mass spectrometry method for soil organic matter characterization (Program Report for 1998). TMAH was developed to provide faster and less expensive routine analysis of phenolic compounds in numerous humic acid samples extracted from different rice soils. Thermochemolysis involves the breakdown of organic macromolecules, such as humic acids, into smaller fragments by reaction with 25% TMAH in methanol at elevated temperature (250 °C). Methylated derivatives are then analyzed by GC (Hewlett Packard 5890 Series II Plus GC equipped with an autoinjector, an electronic pressure control, and a flame ionization detector). A few representative samples were then analyzed with a Hewlett Packard 5890 GC attached to a 5970 mass spectrometer detector to confirm the identity of the phenolic compounds.

The precision of TMAH was adequate to demonstrate several trends in the phenol content of a young organic matter fraction—mobile humic acids in soil from a rice-rice rotation.

- Phenol content was greater in a rice-rice rotation than from a rice-maize rotation.
- During 3 years of the rice-rice rotation, the phenol content of the mobile humic acids (MHA) gradually became greater when crop residues were incorporated shortly before transplanting in anaerobic soil (traditional practice) than when incorporated in aerobic soil during the preceding fallow.
- This difference was accentuated at optimal fertilizer levels.
- The phenol concentration of the MHA decreased from early season to late season following anaerobic decomposition.
- The late-season phenol concentration of the MHA was negatively correlated with the amount of N released from the MHA during the cropping period.

Residue incorporation effects on phenol concentration and N release were agronomically significant, altering release of MHA-bound N by as much as 22 kg ha^{-1}.

Long-term water and straw management. This research seeks to identify and assess the physicochemical mechanism underlying the interaction between soil aeration and soil processes in an intensive rice system. The work will also help elucidate long-term effects of water and straw management on soil properties, rice growth, and sustainability of rice production.

Part of this research project involves the study of the seasonal dynamics of root toxins. Analysis of amino acids, phenolic acids, and other low-molecular-weight organic acids in soil solutions collected from irrigated rice fields was done during the cropping season.

The PICOTAG Amino Acid Analysis System (Waters Corp) was used for analysis of free amino acids. The method involved the derivatization of the sample with phenylisothiocyanate (PITC), which reacts with the amine group of amino acids to produce phenylthiocarbamyl (PTC) amino acids. These amino acid derivatives were analyzed by reverse-phase HPLC using PicoTag column (C18) and 481 UV detector at 254 nm. The HPLC method was slightly modified to separate only the amino acids of interest: glutamic acid, aspartic acid, asparagine, glycine, serine, L-alanine, and threonine.

A method described in the *Journal of Chromatography* (258, 1983. 111-124) was modified for the analysis of the phenolic acids: p-hydrobenzoic, vanillic, coumaric, ferulic, sinapic, salicylic, and cinnamic. Separation was done with a Supelcosil LC-18 (15 cm × 4.6 mm, 3 μm) column heated at 35 °C with gradient mixtures of 5% formic acid and methanol as eluants. A Waters 2487 UV absorbance detector set at 280 nm was used to detect the eluted phenolic acids.

The effects of pH, exposure to light, and presence of Fe ions on the analysis of phenolic acids were also investigated as an adjunct to the study to help in modifying and improving sampling techniques to avoid misinterpretation of data.

BIOMETRICS

The Biometrics Unit performed its traditional functions of statistical consulting, training, and biometrical research and continued development of statistical and database software. The major development was establishment of a Bioinformatics section, which will work in functional genomics and molecular breeding and provide a consulting service for bioinformatics problems.

Statistical consultation

The biometrics group regularly assists with the design and analysis of trials and surveys. We assisted with the analysis of multi-site trials and in the design of multi-environment evaluation trials for northeast Thailand. Collaborators from India, Bangladesh, Thailand, and Indonesia visited Biometrics and Bioinformatics for assistance with analysis and interpretation of research results.

Projects the Biometrics staff were involved in during the year included

- Assessment of the impact of the adoption of mixture planting for biodiversity: impact on pest management and farmers' income (Social Sciences)
- Analysis of Zn deficiency tolerance in rices in the IRRI problem-soil germplasm database (Soil and Water Sciences)
- Control of planthoppers and leafhoppers in rice by the spider *Atypena formosana* (Entomology and Plant Pathology)
- Genotype × environment (G×E) interaction analysis of rice blast nursery data in Korea

Biometrics training

Biometrics and Bioinformatics conducted eight courses on agricultural statistics (Table 2).

Biometrics research

Biometrics for analysis of G×E interactions. Pattern analysis methodologies adapted for the analysis of G×E interaction in rainfed lowland rice were used to develop understanding at regional G×E levels in northeastern Thailand, India, Bangladesh, Indonesia, and Philippines, and, on a larger scale, across all countries. This work, in close collaboration with the Rainfed Lowland Rice Research Consortium, will continue with a second phase wherein reference genotypes will be used to characterize rainfed lowland environments through numerous small trials. This work will ultimately help focus rainfed lowland breeding efforts and to identify new traits for the development of stress-tolerant varieties.

Grain quality surveys. Biometrics was involved in the IRRI-National Food Authority project on quality of milled rice in the Philippines. It had two survey components:

- A survey of rice retailers to assess the Philippine Grains Standardization Program (PGSP). This also indicates consumers' preferences for rice based on the volumes of rice sold at the retail outlets.
- The collection and analysis of rice samples sold at those retail outlets to determine if they conform to PGSP standards.

Database development and deployment

International Rice Information System (IRIS). IRIS is fully functional for managing germplasm enahancement and evaluation data. Biometrics was involved in developing methodologies for data mining to answer questions about tolerance of germplasm for different soil streses. The work, in collaboration with the Soil and Water Sciences Division, used historical soil stress evaluation data in IRIS.

A prototype web interface for IRIS was developed and will be published in 2001. A specialist

Table 2. Courses conducted by Biometrics and Bioinformatics during 2000.

Course title	Participants (no.)
Basic experimental design and data analysis	23
Introduction to SAS for Windows (20-24 Mar)	18
Advanced experimental designs (27-31 Mar)	15
Cluster analysis (8-12 May)	16
Principal component analysis (15-19 May)	14
Introduction to IRRISTAT for Windows (14-18 Aug)	24
Introduction to GxE analysis (21-25 Aug)	19
Analysis of unbalanced data (11-15 Sep)	5
Total	134

web page for the IR64 mutant database was also created. Information on about 200 mutants is in the database. It is queried using the rice plant image and a treelike trait list.

IRRISTAT development

The IRRISTAT statistical package for Windows was improved during the year with the addition of graphics facilities for the presentation of the analysis of G×E interactions. Several improvements were made to the interface and ease of use of the software, and IRRISTAT is available as an IRRI publication for a nominal cost, or at no cost, by FTP download from the IRRI web site.

Bioinformatics

Bioinformatics, new for 2000, is concerned with all aspects of biological information acquisition, processing, storage, distribution, analysis, and interpretation. It combines the tools and techniques of mathematics, computer science, and biology and aims to distill biological knowledge from a variety of data sources.

IRRI's overall objective in bioinformatics is to manage and share high-quality, integrated, and relevant data analysis and interpretation with NARS and other partners and to globally publish relevant and interesting data on all aspects of rice science.

A joint project between IRRI, CIAT, CIP, CIMMYT, and NCGR was developed for the integration of ICIS with comparative mapping tools being developed by NCGR. This project has a larger overall objective of assessing the opportunity for CGIAR centers to collaborate in the area of bioinformatics for comparative genomics and to center this collaboration on NCGR.

Significant progress was made with the establishment of a Bioinformatics group. Efforts will be concentrated on functional genomics and molecular breeding, making sure that advanced bioinformatic tools and advice are available to IRRI researchers and collaborators.

COMMUNICATION SUPPORT

The Communication and Publications Services (CPS) provides communication support for the entire institute. The services include editing, graphic design, art and illustration, audio-visual, photography, video, and printing.

The unit printed 2,122,969 pages of text, not including IRRI books, which were contracted out. About 8,415 original slides were produced; 906 slides duplicated; and 7,351 black-and-white photographs printed. IRRI graphic artists produced 396 illustrations, laid out 1,880 pages for publication, and prepared 112 posters.

Other activities are reported in Accelerating the Impact of Rice Research Program. In addition to the work reported there, IRRI editors worked on 193 journal articles and miscellaneous papers (conference papers, proposals, posters, abstracts, and others) totaling about 4,305 pages of text, tables, and figures.

COMPUTER SERVICES

Infrastructure

Two new CISCO 3640 routers give IRRI a high-speed Internet connection to PHNET, a national research and education network. PHNET, based in Makati, Philippines, is a member of the Asia Pacific Advanced Network (www.apan.net), which IRRI has used for video conferencing in the region. When IRRI got its fulltime Internet link in 1995, a link to the United States was the best option. The Internet has changed dramatically since then and a local connection is by far the best option.

Tenders were issued for replacement of the integrated voice and data network. Although IRRI will move to a local Internet link in 2001, the current leased line to the United States will be retained for voice communications on a lower capacity circuit. IRRI will thus retain free calls between CGIAR centers, for U.S. phone numbers for incoming calls and faxes, and access to U.S. toll-free numbers.

Software development

All IRRI-developed applications survived the Y2K problem. A special Y2K task force was set up by Computer Services and all affected systems were retired or replaced. Only one application had problems after 2000 and it was not related to Y2K.

Sourcing a project management solution from another center. IRRI started running project manager software provided by CIAT, through the efforts of a CIAT staff member who visited IRRI. CIAT's willingness to share the software application saved IRRI from having to create software already in ex-

istence. The CIAT staff member returned to CIAT with shared IRRI-developed applications. The IRRI director general sent thanks to CIAT for its willingness to share their project management application with the rest of the CGIAR system, citing it as tangible evidence of a new spirit of cooperation in the system.

Services

Better bandwidth management. Computer Services introduced new software to regulate the use of the institute's Internet connection by blocking undesirable sites. A lot of IRRI's bandwidth was being dissipated by screensavers, and the like, users of which had no idea that their use was having an adverse impact on the usability of the net.

Introduction of network attached storage devices. Most of IRRI's digital information has been held on the hard disks of individual PCs. Computer Services introduced low-cost network storage systems designed to begin the process of migrating information from PCs to the IRRI network, where it will be backed up regularly, and where it can be accessed from other computers. That will eventually include those in the homes of IRRI scientists.

Policy

IRRI's organizational units have ventured into web publishing more or less independently, with the result that IRRI's Intranet is scattered over many servers throughout the institute. Computer Services reached an agreement with CPS to consolidate IRRI's Intranet on systems managed in the CPS building, which Computer Services now shares with CPS. Other divisions will be persuaded to let Computer Services host their information centrally. This will facilitate storage management—making backups and offline copies of information (e.g., on CD-ROM) for dissemination to NARS and other partners.

EXPERIMENT STATION

The Experiment Station (ES) served 226 requests for land and facilities and provided support on 238 ha of fields (Table 3).

Nursery requirements for 2000 totaled 7.19 ha (3 ha drybed and 4.19 ha wetbed) provided and maintained by the station staff. The drybeds were constructed with a modified tractor-powered rototiller with a flutted roller to mark rows as furrows. Work started on development of a wetbed maker attached to the 4-wheel tractor for lowland wet soil to prepare wetbeds. We expect a reduction of labor to about 50% in the wetbed nursery preparation.

Almost 70 t of fertilizer materials were applied during the year. ES planted and harvested 19.7 ha of lowland fields for breeder seed increase and seed production. Crop establishment in seed production plots was mechanized using a mechanical transplanter, a backpack seed blower-spreader, or direct seeding. The Thai combine harvester was used to harvest and thresh seed production plots and borders of experimental plots, but it got minimal use during WS due to mobility problems in deeper fields.

A total of 163 t of different rice materials were processed (threshing, drying, cleaning, storing) from harvests of seed increase, seed production, and border rows of experimental plots. Plant Breeding, Genetics and Biochemistry (PBGB), which occupies 60% of the requested area, increased field planting by almost 32%.

Integrated pest management (IPM) was practiced in some of the seed increase and seed production areas. Insecticide use increased by 10% and molluscicide use by 88% over 1999 levels, mainly due to an increase in area planted. However, herbicide use was reduced by 36% due to limited applications because of prevalence of rainfall during the year. Pesticide applicator exposures to agrochemicals continue to be reduced with the use of mechanized equipment.

ES provided rat control services consisting of 2,275 baiting stations installed with 1,550 kg of rat

Table 3. Support provided to IRRI research divisions by the Experiment Station during 2000.

Division	Dry season (ha)	Wet season (ha)
Plant Breeding, Genetics, and Biochemistry	70.04	74.95
Genetic Resources Center	15.28	3.89
Soil and Water Sciences	16.80	11.11
Experiment Station	11.30	8.36
CIAT	4.00	4.00
Entomology and Plant Pathology	6.56	5.43
Agricultural Engineering	4.68	1.36
Training Center	0.51	
Total	129.17	109.10

baits for research station and outreach areas. In addition, active barrier system fences for 95.92 ha, with 1,038 live traps, were installed. Nearly 5,000 rats were caught during the year. About 5,626 m^2 of bird nets were also installed.

Improvement in the irrigation system continued with the installation of polyvinyl chloride irrigation pipes in Block G11, UM and UN, and installation of cement pipes at Series 600. An additional 64 manholes were installed at Blocks E, G11, M8, N, UB, UC, UE, UF, UG, UL, UN, UQ, UR, UU, UV, U, and Series 200, 300, 600. Drainage outlets were developed and constructed in Blocks G11, UE, UF, UG, UU, UV, UY, and Series 600. Drainage rehabilitation work continued at Blocks B2, UJ, UN, and UQ. Underground pipes were lowered or slopes improved.

Land development work consisted of conversion of upland to lowland fields in the whole block of UD (4 ha) to provide additional area for GRC nurseries and other uses. Major road rehabilitation and repair work were done in Block A, Road 26 North, screenhouse roads, and the main road of old lowland and upland areas. Backfilling and reshaping of plots beside 500 reservoir and the entrance of IRRI (beside the railroad) were completed.

Controlled growth facilities and grounds

The Controlled Growth Facilities and Grounds (CGFG) Unit supported a total of 34 experiments in the phytotron, 140 experiments in greenhouses, and more than 16 experiments in the confinement level 4 (CL4) transgenic greenhouses. A total of 3,261 maintenance service requests were served, which included provision of 875 t of ground soil to various experiments in the greenhouses and fields.

The annual shutdown of the phytotron started 15 d earlier than the customary December shutdown. Servicing of the various facilities was staggered over a 45-d period to facilitate earlier scheduling of experiments by researchers before 2001, help reduce work peaks and holiday rush that typically occur every December, and avoid overtime costs associated with holidays.

Thirty-two type-M solar panels were installed as part of the gradual replacement program for the old model solar panels of the phytotron solar heating system. Replacement of all old panels will be completed in 2001. Worn-out insulation on the hot water lines and air-handling units of the glasshouse bays were replaced. The pressure tank that services the growth cabinets was replaced with a more suitable and reliable unit. New hermetic and semi-hermetic compressors were acquired as part of the replacement program for the chillers servicing the phytotron cooling system.

Polyvinyl pipes were installed in the roof gutters of the phytotron building to collect rainwater in an existing concrete tank. This augments the rainwater supplied by the underground rainwater collecting tank that services the humidification and cooling systems of the growth chambers. The two rainwater tanks combined help the phytotron save the use of more than 400,000 L of demineralized water annually. This system, in combination with the reverse osmosis water supply pipe connection of the phytotron to the Umali Laboratory, replaced inefficient electric boiler and demineralizer units.

Power consumption of the phytotron for the year was 167,200 kwh lower than for 1999. Compared with 1989 and 1990 levels (2,738,400 kwh at $139,795 and 2,523,200 kwh at $123,329), the current power consumption represents 41–46% reduction. This translates to US$71,000–87,800 annual power-cost savings attributed to modernization and improved systems at the phytotron.

Greenhouse Unit

The Greenhouse Unit maintained 44 glasshouse and screenhouse structures and provided a wide range of services to facilitate experiments in them. Soil grinding and hauling remained a main bulk of daily operations. An increase over 1999 of about 175 t pulverized soil for greenhouse and field experiments was noted.

The greenhouse crew accomplished a one-month preventive shutdown for 24 greenhouses on a staggered schedule, which allowed servicing of at least two greenhouses each month. Shutdown services included general cleanup and surface washdown of all the structures and provisions for prophylactic chemical treatment against pests. Preventive maintenance of cooling systems and structures was also done. The shutdown operations as standard procedure in all greenhouses are primarily aimed to disrupt insect and disease cycles and reduce the frequency of chemical spraying against pests. It is also

a proactive approach to maintenance of machinery and structures in the greenhouses.

Some 200 m^2 of the Entomology and Plant Pathology Division's plant-growing and insect-rearing areas were concrete paved to reduce ground maintenance costs, improve aesthetics, and facilitate staff access to experimental setups. A new higher capacity soil heat sterilizer was acquired to meet increasing demand for soil sterilization.

The headhouse at cluster N, razed by fire in 1999, was fully restored and is back to normal operation. Asbestos roofing of another headhouse at cluster M was replaced with standard metalplas roof sheets. Improvements in the upland screenhouse complex include installation of steel covers for the drainage, repainting of support structures, replacement of screen walls, and reinstallation of the misting system for the maintenance of some wild rice species.

Light transmission of metalplas greenhouse roofing was measured at only 70% compared with glass with light transmissions reaching as high as 90%. Agronomic lamps were installed in one metalplas-covered greenhouse to augment light levels during periods of limited sunlight. The lamps were found to increase light levels up by as much as 20% but with an associated increase in temperature at the plant canopy level by 1 to 2 °C. A new polycarbonate roofing material, with light transmission of 90%, was installed in a greenhouse and is being tested. The new material is fire retardant, lighter, less fragile, cheaper, and safer to use than glass.

Grounds Unit

The Grounds Unit provided landscape maintenance and development services, including garbage collection, to the main research center and to 104 residential units and common areas of staff housing and IRRI-rented apartments.

Road widening was done at the entrance to the parking area of grounds equipment near the phytotron to improve safety and facilitate the maneuver of heavy equipment. Old hedges around the F.F. Hill, Umali Laboratory, and Physical Plant buildings were removed and replaced as appropriate. Seven-year-old coconut trees were cut down for safety considerations and trimming of trees was done in some communal areas to help avoid potential accidents due to broken tree branches during windy days.

Implementation of the waste segregation and recycling program continued generating funds through periodic sales of recyclable wastes via public auction and has caught the attention of various groups and organizations taking interest on waste management. IRRI staff have been invited on several occasions to share information and expertise on the topic.

Two hundred and fifty plant identification labels were installed on different plant species in the staff housing, guesthouse, and some communal areas. Five seedlings of the rare vine *Mucuna benettii* were successfully propagated this year as a result of previous joint efforts between the Makiling Botanic Gardens, Institute of Forest Conservation, and the IRRI Grounds Unit to develop macro-propagation techniques that will help conserve the species.

Additional improvements to IRRI's grounds include the construction of a new passageway and bridge as well as a new parking lot near the IRRI main gate to improve traffic flow of people and vehicles visiting the IRRI Riceworld Museum. Grounds development was also initiated along the concrete paved road leading to the staff housing and along the perimeter fence of the IRRI main entrance gate in coordination with UPLB staff.