IFDC

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an update on the work & progress at the International Fertilizer Development Center

Headquarters—

Phosphate Training Taps Valuable Resource

Beneath some of the most infertile land of the tropics and subtropics lies one of the keys to solving food shortages. Numerous deposits of phosphate rock represent a valuable but often untapped resource for the domestic production of fertilizers.

Since its inception in 1975, IFDC has strived to help developing countries find ways to use their phosphate resources in fertilizer production. As an extension of this ongoing program, the Center conducted a 3-week training program entitled "Development of Indigenous Phosphate Deposits" at Headquarters during May 20-June 6, 1985.

The program brought together 28 participants from 19 countries. Among this group were geologists, mining engineers, chemical engineers, chemists, soil scientists, agronomists, and economists. The group considered multidisciplinary problems connected with the development and use of indigenous phosphate deposits as fertilizers.

IFDC fertilizer specialists reviewed with the participants the latest phosphate research and technology findings through the use of modern research methodologies and equipment. They examined difficulties presently being encountered in the development of phosphate resources and their use in agriculture in several areas of the world as illustrated in IFDC projects in Africa, Asia, and Latin America.

The program consisted of formal presentations, case studies, group discussions, and a practical phase involving demonstrations in the laboratory, pilot plant, greenhouse, and field, as well as field trips to commercial operations. Participants were provided an opportunity for interaction in raw material evaluation, mining and beneficiation, process technology, and agronomic requirements.

Prior to the beginning of the program, participants were invited to send samples of indigenous phosphate ores from their countries. Ore samples were received from India, Mexico, Nepal, Nigeria, Tanzania, Togo, and Venezuela. These samples were analyzed for the main chemical and mineralogical factors that might affect their use in fertilizer production.

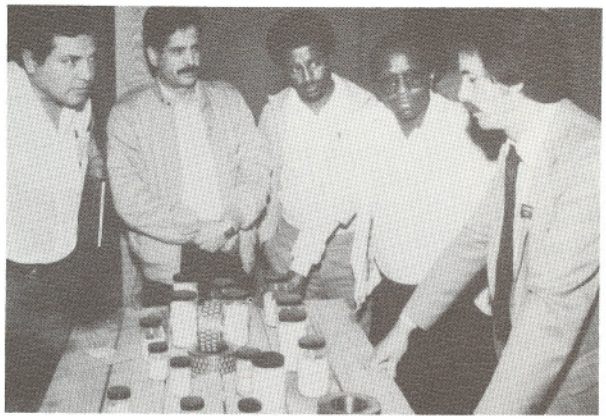
A unique feature of this program was a session during which these ores were discussed and their potential for fertilizer production was evaluated. Information was presented on such topics as characterization, mineralogy, mining, beneficiation, production cost estimates, the amount of savings realized by producing partially acidulated phosphate rock as opposed to other products, transportation costs, expected grades, and necessary modifications to existing plants.

One of the participants, Dr. Ranjit Choudhuri of Rajasthan State Mines and Minerals, Ltd. (RSMML), in India, was particularly interested in this program since his company had previously cooperated with IFDC in carrying out beneficiation studies of Jhamarkotra ore from India. During 1983 IFDC conducted basic mineralogical and petrographic studies of the ore, followed by two phases of laboratory-scale investigations on beneficiation. Results of the investigations were sufficiently promising for IFDC to undertake pilot-plant tests during late 1983 to confirm the laboratory research. The basic difference between IFDC's findings and those of earlier studies by the Indian Bureau of Mines (IBM) and other groups was that the IFDC study showed that the ore did not have to be extremely finely ground to perform well during beneficiation.

The Indian company is presently evaluating this process modification for possible implementation in their 250-tonne-per-day plant. Choudhuri is optimistic about the outcome.

"IFDC's independent study complemented our work and increased our confidence in the IBM process, which has not been commercially tried elsewhere," he said. "IFDC's more comprehensive study showed that the phosphate rock could be liberated at a relatively coarser grind than the practice (IBM process) that we had adopted earlier. The IFDC process has two benefits: it reduces the cost of grinding by separating the rock at a coarser particle size and reduces the amount of reagents consumed during flotation."

Choudhuri found this training program to be practical and down-to-earth. However, other participants challenged the IFDC staff to "think small." At the conclusion of the program, a spokesperson for the participants put it this way, "Some of the production technology that we have heard discussed is too costly for developing countries; we need simpler processes for small-scale plants. In addition, the leached and weathered tropical soils are highly acidic and need not only nitrogen and phosphorus but also calcium, magnesium, sulfur, zinc, copper, etc. IFDC should consider helping developing countries to solve these problems." ■



Jose R. Lazo de la Vega, IFDC Special Project Engineer (extreme right), discusses with the phosphate training participants the compaction/granulation process as an alternative for the production of phosphate-containing fertilizers.

Headquarters and India—

Mussoorie Project Saves Millions in Foreign Exchange

The direct application of Mussoorie phosphate rock has saved India US $6.6 million in foreign exchange during 1984, according to Mr. T. N. Jaggi, Chairman of Pyrites, Phosphates, and Chemicals, Ltd. (PPCL), a public-sector undertaking of the Indian Government.

Agricultural surveys have shown that 49 million hectares of Indian land in the humid tropics have acidic soils, and direct application of phosphate rock has helped reclaim such soil during the very first year. For cultivators of acidic soils, Mussoorie phosphate is a goldmine because its 40%-45% calcium content removes the calcium deficiency, and other nutrients in the rock increase plant yields, according to Jaggi.

In January 1983, the United Nations Industrial Development Organization (UNIDO) contracted with IFDC on behalf of PPCL to improve the handling properties of Mussoorie phosphate rock for direct application through minigranulation and also to further the use of this rock through production of partially acidulated phosphate rock (PAPR). The Mussoorie deposit contains about 45 million tonnes of low-grade phosphate rock (see *IFDC Report*, Vol. 8-No. 4).

"IFDC has now completed process demonstration trials—minigranulation and single-step acidulation and granulation for production of PAPR," said Dr. A. H. Roy, IFDC Special Project Engineer and coordinator of the technology portion of the project. "We have looked at the production of PAPR (using sulfuric and/or phosphoric acids) from both run-of-mine Mussoorie phosphate rock and concentrate prepared by Sala International of Sweden. We found it feasible to produce PAPR from both materials although fewer processing problems were encountered with concentrate since the run-of-mine ore has a relatively high level of carbonates."

According to Dr. L. L. Hammond, IFDC Soil Scientist and coordinator of the agronomic evaluation portion of the project, initial agronomic testing has been completed in IFDC laboratory and greenhouse facilities. These tests evaluated crop response to phosphorus from each of the materials when applied to soils similar to those found in India.

"Minigranulation of unacidulated Mussoorie rock using potassium chloride or sulfuric acid as binders had little influence on its agronomic effectiveness," Hammond said. "Similar results can be expected from these products as compared with finely ground Mussoorie rock used for direct application to acid soils. Significant increases in effectiveness were observed, however, when a small quantity of phosphoric acid was used as a binder. With each of these products, physical properties related to handling and application were improved."

R. K. Puri, PPCL Mechanical Engineer (left); IFDC Technical Aide M. E. Goode; and B.V.M. Rao, PPCL Project Coordinator, examine the shell of a pinmixer, which was used in the minigranulation trials.

The greatest improvement in agronomic effectiveness was observed when Mussoorie rock was acidulated with 40%-50% of the sulfuric or phosphoric acid required for production of superphosphate. The evaluation indicated that this PAPR would be expected to produce a crop response equivalent to that obtainable with fully acidulated rock.

During the process demonstration trial of 1984, IFDC prepared several promising products selected from the IFDC greenhouse studies for field trials in India. Five experiments were initiated during the 1984 Kharif season in collaboration with several Indian institutions. The experiments were designed to continue for at least an entire crop rotation, typically with rice being the indicator crop in the Kharif season followed by wheat or pulse in the Rabi season.

These rotations have now been completed, but the results have yet to be analyzed. Preliminary yield data from the 1984 Kharif season tend to verify the predictions of the greenhouse screening tests. Final evaluation of the yield results for both seasons and analysis of plant and soil samples from the experiments will be conducted at IFDC later this year.

According to PPCL's present plan, a demonstration plant with an annual production capacity of 60,000 tonnes will be set up in India to demonstrate the production of partially acidulated and granulated phosphate rock. PPCL has tentatively agreed for IFDC to conduct pilot-plant testing and provide process information and an equipment list for the demonstration plant.

According to Jaggi, future plans also include the construction of a commercial plant. This commercial plant is certainly needed as can be readily determined by projected demands. The PPCL chairman said recently that the demand for phosphate rock for use on acidic soils is increasing from one crop season to another, and the projected demand is estimated at 6.4 million tonnes for 1990. All-out efforts are being made to achieve self-sufficiency in phosphate fertilizers by 1997.■

Headquarters—

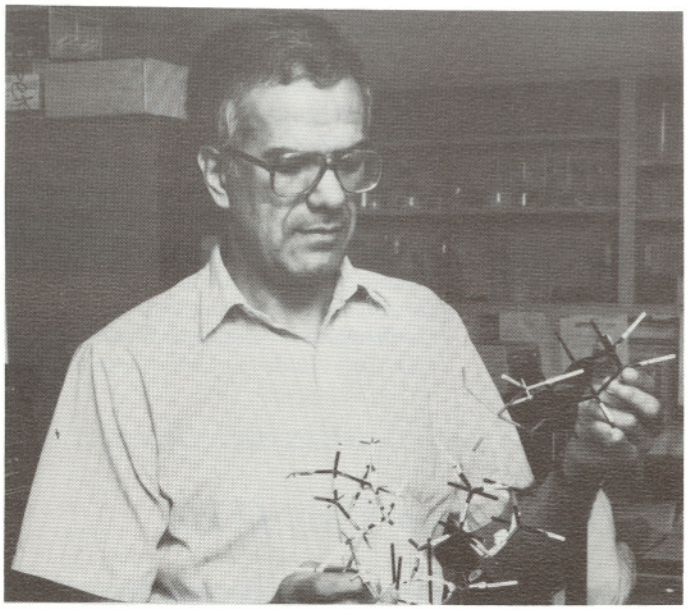
MORE STABLE, COST-EFFECTIVE, LONGER LASTING INHIBITORS: PROJECT GOAL

Under the direction of Dr. Ramiro Medina, Enzyme Biochemist from the Technical University of Munich, Germany, a team composed of IFDC and TVA/NFDC scientists are cooperating to synthesize and evaluate a new group of urease inhibitors that have great potential in decreasing the losses of fertilizer nitrogen from urea.

This project is partially sponsored by the Deutsche Gessellschaft für Technische Zusammenarbeit (GTZ) of Germany (see *IFDC Report*, Vol. 8-No. 4).

Urease is an enzyme that is present in soils. When exposed to soil containing urease, urea—the most important fertilizer in developing countries—undergoes rapid hydrolysis (decomposition) to ammonia and carbon dioxide. Control of the rate of ammonia formed during urea hydrolysis in rice paddies should lead to improved nitrogen use efficiency. The objective of the IFDC project is to combine a small quantity of a chemical (inhibitor) with urea to control urease activity and thereby control the urea hydrolysis rate.

In a recent interview prior to his return to his home institution, Dr. Medina reminisced about the past 2 years. "It has been a very exciting, productive time," he says. "Our activity has increased very rapidly. We are investigating many alternatives while trying to develop urease inhibitors that are very effective and have immediate and sustained urease inhibition. We are also carrying out experiments in connection with the stability of inhibitors—one of their most important characteristics. The new class of inhibitors now being developed at IFDC may have more stability than the urease inhibitor phenylphosphorodiamidate (PPD), which is being used now."



Using molecular models, Dr. Ramiro Medina, Enzyme Biochemist, studies the interaction of inhibitors and the active site of urease.

What are the potential benefits of the inhibitors?

"If we are lucky enough to develop a powerful inhibitor with immediate and sustained inhibition, we can reduce ammonia losses through volatilization and save developing-country farmers millions of dollars," he says. "If, at the same time, we increase the yield of rice—the basic food of two-thirds of the world's population, then the solution is perfect. We still have a long way to go; we need systematic research work at the laboratory, greenhouse and field level."

IFDC has initiated greenhouse and field evaluation of inhibitors at Headquarters and the International Rice Research Institute (IRRI) in the Philippines, respectively.

In discussing the greenhouse evaluation, B. H. Byrnes, IFDC Research Associate, has this to say: "Since the newly developed inhibitors must first degrade to other compounds before they exhibit appreciable urease inhibition, they may have to be added to the soil before fertilization with urea. This presents significant problems not only in the method of applying the inhibitors but also in the correct timing of the inhibitor and urea applications. In actual greenhouse and field experiments, this problem has not yet been overcome, and significant inhibition has not been achieved. The degradation rate of the inhibitors may depend on soil characteristics, temperature, and other factors. The evaluation of the factors that affect the performance of the inhibitors will continue. IFDC hopes to eventually achieve better urease inhibition with these compounds."

Dr. R. J. Buresh, IFDC Soil Scientist stationed at IRRI, is conducting the field evaluation in cooperation with Dr. S. K. DeDatta, Head of the IRRI Agronomy Department. Findings on this portion of the project will be reported as available.

Dr. Medina plans to return to IFDC occasionally in the future on a consultant basis. At that time he will evaluate the experiments and results and advise the team on the project's continuation.

"GTZ is happy with the results of Phase I of the project," Medina says. "We look forward to beginning Phase II."

The objective of Phase II will be to develop inhibitors that are effective from the time of application, eliminating the gap in inhibition that has been encountered during the first 2 weeks. The team also plans to develop a new nitrification inhibitor that can be combined with their known urease inhibitors.■

Africa—

RESEARCH NETWORK HELPS SOLVE AFRICA'S FOOD PRODUCTION PUZZLE

A research network of soil scientists, agronomists, and social scientists, which was established 3 years ago by IFDC, is working with African countries to find ways of using their own native fertilizer resources to grow more food.

At a recent symposium entitled "The Management of Nitrogen and Phosphorus Fertilizers in Sub-Saharan Africa," 57 scientists from 17 countries reviewed the results from IFDC's African Fertilizer Research Program. The symposium was held in Lome, Togo, during March 26-28, 1985, and brought together a group of prominent scientists from international and national agricultural research centers in tropical Africa who have participated in the program, which is coordinated by Dr. Uzo Mokwunye, IFDC Soil Scientist.

Collaborating with IFDC on the research and the symposium were the International Institute of Tropical Agriculture (IITA) in Nigeria and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in Niger. Funding for IFDC's fertilizer research program for Africa came from the International Fund for Agricultural Development.

"Different agroclimates exist in tropical Africa," Mokwunye says. "Crop-growing conditions are different for each agroclimate. The network approach enables IFDC to introduce results obtained at appropriately located benchmark sites into the national research programs of the various members of the network. Relevant findings are used as a basis for onfarm research and validation tests on farmers' fields. Experiences of different network members are shared during annual workshops and symposiums."

It was the consensus of the network members attending the symposium that the most immediate and direct way to solve Africa's food problem is to make fertilizer available to the small farmer.

IFAD project collaborators with Dr. Bruce Christianson (left foreground), IFDC Soil Scientist, sample maize plants for ^{15}N analysis in Togo.

IFDC's Managing Director Dr. Donald McCune puts the African situation into perspective. "Direct food aid, which is being offered by a myriad of benefactors, can help alleviate the present hunger problems of Africa, but a long-term solution requires the establishment of a more stable agricultural sector in each country."

To revive the ailing agricultural sectors of African countries requires the use of a combination of ingredients including fertilizer, improved seeds, insecticides, pesticides, effective extension services, and reasonable pricing policies.

Most of the fertilizer used in Africa is imported at a very high cost. Thus, Africa's fertilizer consumption is the lowest in the world. One of IFDC's goals is to help African countries use their own resources for fertilizer wherever that is economically and technically feasible.

In 1981 IFDC began its formal field research in Africa; this research in part focuses on the use of African natural resources in the production of nitrogen and phosphorus fertilizers. Since that time IFDC has had three staff members stationed in Niger and Nigeria. Their research has been conducted in collaboration with a network of scientists in Benin, Burkina Faso, Cameroon, Gambia, Ivory Coast, Kenya, Liberia, Malawi, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo, Zambia, and Zimbabwe.

In many of Africa's countries, the land itself holds one of the keys to solving the food production puzzle—it has phosphate rock. The IFDC research network has studied phosphate deposits in Benin, Burkina Faso, Mali, Niger, Senegal, Togo, Uganda, Zambia, and Zimbabwe. The phosphate rock from the deposits of Mali and Senegal (Matam) are suitable for direct application; that from other deposits has to be processed to be effective during the first year after application.

"Data from the first 3 years of our research indicate that phosphorus is the most limiting nutrient in Sahelien west Africa while nitrogen is most important in the more humid regions," Mokwunye says. "Approximately one-half of the fertilizer nitrogen applied to Sahelien soils is lost. In years of high rainfall much of the fertilizer nitrogen applied in the humid region is lost. Incidences of sulfur, potassium, zinc, and magnesium deficiencies have been noted across all agroclimatic zones. In some cases, the inclusion of sulfur in phosphate-carrying fertilizers more than doubled the response to phosphorus."

"Because of the diversity in soils and crop-growing conditions in sub-Saharan Africa, IFDC hopes to operate the present network as two more easily manageable units in a West African Fertilizer and Fertilizer Management Evaluation Network and an East and Southern African Fertilizer and Fertilizer Management Evaluation Network," Mokwunye says.

To help bring fertilizer know-how to the small farmer, IFDC is interested in establishing more contacts with the agricultural people in the tropics and subtropics by establishing regional fertilizer centers. In this light, the Scientific Technical Research Commission of the Organization of African Unity (STRC/OAU) has requested assistance from IFDC in establishing an African Center for Fertilizer Development. IFDC has developed a plan for establishing this Center and is presently awaiting the "go-ahead" from OAU.■

Two Chinese Delegations Visit IFDC

Minister Qin Zhongda (extreme left) and his delegation of seven officials from the Ministry of Chemical Industry, Beijing, People's Republic of China, visited IFDC on May 31 to discuss advances in fertilizer technology, production, and distribution in a joint meeting with the National Fertilizer Development Center/Tennessee Valley Authority.

Headquarters—

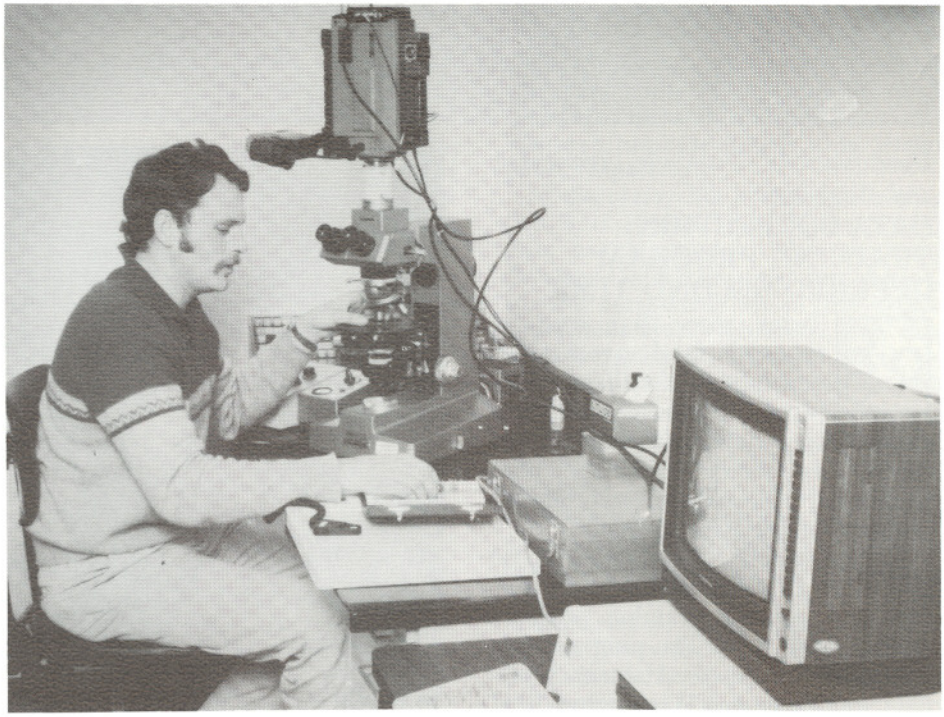
NEW COLOMBIAN PHOSPHATE ROCK EVALUATED

At the request of Fosfatos del Huila, S.A., of Neiva, Huila, Colombia, IFDC recently conducted an evaluation of a newly discovered deposit of phosphate rock, located in south central Colombia near the Andes Mountains.

During the past 20 years Colombia has focused much attention on the development of its indigenous deposits of phosphate rock, and IFDC has played an important role in assisting that country in developing its natural resources so that they can be used in the production of fertilizer to meet domestic needs.

During the 1960s Colombia, with help from the U.S. Geological Survey, conducted an extensive exploration program and found that it possessed rich deposits of phosphate rock, the most prominent of which are located at Sardinata and Pesca. These two deposits proved to possess great potential and have been studied by IFDC and other organizations for several years. Another phosphate deposit that was discovered later was the Huila deposit, located fairly close to the newest discovery.

The latest discovery is called the Media Luna deposit. A run-of-mine sample of this ore was received at IFDC during 1984 and was chemically and mineralogically characterized to evaluate its potential as a fertilizer raw material. IFDC fertilizer technologists determined that the rock is a medium-grade ore composed of phosphate, calcite, and quartz. The ore has good potential for direct application. It is a relatively pure rock with respect to all impurities except calcium carbonate. It is now an economic decision whether to remove this carbonate prior to fertilizer production or use it directly in the selected process.



Steven Van Kauwenbergh, IFDC Mineralogist, uses an image analyzer to determine the particle size, range, and shape of minerals in Media Luna phosphate.

Using sulfuric acid, IFDC technologists produced partially acidulated phosphate rock (PAPR) with 50% available P_2O_5. After conducting experiments on the rock, they found that it is feasible to produce PAPR using IFDC's single-step acidulation and granulation process. ■

A delegation from the Chinese Mines Research and Design Institute, sponsored by the Carl Duisberg Society, visited IFDC during May 16-17 to discuss the latest technology in phosphate ore processing. TVA assisted IFDC in hosting the discussions.

Training Program Activities

Headquarters; Nashville, Tennessee; and Washington, D.C.—

DATA COLLECTION TRAINING PROGRAM OFFERED SECOND TIME

Today, more than ever, increased food production depends on fertilizer as an input. Planning and implementing policies and programs for the fertilizer sector require that data be properly collected and analyzed and accurate projections be made.

To help supply trained people to do this work, IFDC offered a data collection and analysis training program during April 8-28. The program was held in Muscle Shoals, Alabama; Nashville, Tennessee; and Washington, D. C.

Twenty-four participants from 16 countries learned the latest techniques of data collection and analysis through lectures, case studies, discussions, and "hands-on" activities using microcomputers. To gain a practical viewpoint, the group went on field trips to various agencies and organizations involved in fertilizer sector data collection, analysis, and projections. Those attending heard presentations by specialists from British Sulphur Corporation, the Food and Agriculture Organization of the United Nations, IFDC, various U.S. Government agencies, the World Bank, The Fertilizer Institute, the Potash and Phosphate Institute, and the Fertiliser Association of India.

Andres Eduardo Abramovich, one of the participants, found this training program especially useful in that he was able to exchange information with the others and compare their problems and situations with his own. In Argentina Abramovich is an advisor to the Secretary of Agriculture. During an interview, he told of his experiences as the manager of the national fertilizer program, which was established during 1984/85.

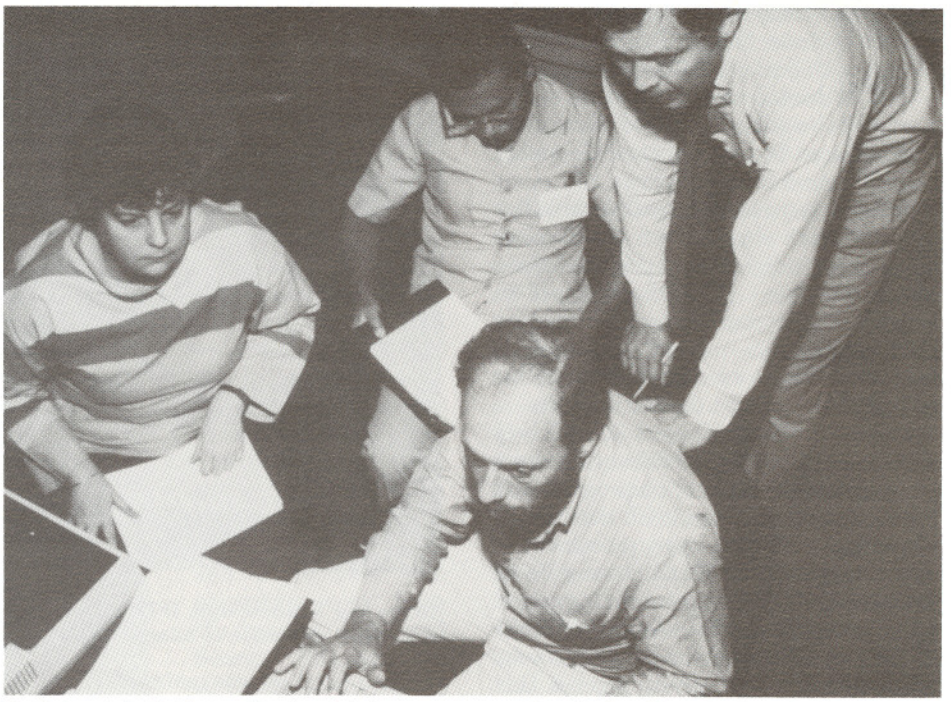
"Through the national program the Government imports fertilizer to cooperatives and grain dealers at a fixed in-kind price, which is paid at harvest time," Abramovich said. "Then the private sector distributes the fertilizer to farmers."

By this means, the price of fertilizer is reduced by one-half; financing problems have been solved; and fertilizer used has increased threefold in the first year of the program.

"Prior to the inception of the program, 25,000 tonnes of urea was applied to wheat per year; after the new program began, 75,000 tonnes of urea was applied per year; and during 1985/86, it is projected that 150,000 tonnes will be distributed," he said.

The main objective of the program was to expand the demand for fertilizer and to establish a situation for a stable market by creating incentives for the private sector to embark in the fertilizer business. The fertilizer program is really a part of a more comprehensive plan to increase agricultural productivity through the use of better seeds, insecticides, herbicides, cultural practices, financing, etc.

To plan fertilizer programs such as that of Argentina requires the analysis of accurate data in order to make projections. IFDC's data collection training program gave its participants this kind of background. ■



Participants in the data collection training program watch as Andres Eduardo Abramovich of Argentina completes an exercise on a microcomputer. G. T. Harris, manager of the program, is pictured in the right background.

U.S.A.—

NEW TRAINING PROGRAM REVEALS U.S. ADVANCES IN FERTILIZER PRODUCTION, MARKETING, AND USE

Eighteen general managers of fertilizer companies from 10 developing countries recently learned first hand the advances in fertilizer production, marketing, and use as they traveled across the United States.

This new training program, "Advances in Fertilizer Technology, Marketing, and Use in the United States," was held during May 5-24. The group visited fertilizer marketing and production facilities in San Francisco, Fresno, and San Diego, California; Phoenix, Arizona; Tulsa and Oklahoma City, Oklahoma; Lafayette and New Orleans, Louisiana; Tampa, Florida; Chicago, Illinois; Glasgow and Louisville, Kentucky; and West Lafayette, Indiana.

During this program the participants gained new ideas for possible use in their operations. A few of the topics covered included: the manufacture and marketing of fertilizer by retailers for intensive irrigated food crop production; drip irrigation and fertilization on a commercial scale; manufacture of liquid fertilizer; appropriate agricultural policies for fertilizer sector development; processing of phosphate ores; storage; handling; and shipment by rail, barge, pipeline, and truck.

One of the participants, Herre Bartlema, Head, Department of Development and Agronomics of U.K.F., Utrecht, the Netherlands, felt that the program offered many ideas that could be adopted in developing countries. One example is the fertilizer marketing system of the United States.

"Fertilizer marketing in the United States is highly efficient," Bartlema said. "The participants from developing countries can learn from what they have seen in the United States and apply it in their countries. Another example of technology that is applicable to developing countries is the irrigation system used in Arizona; this could be used in the arid tropics."

The program proved that developing-country officials can learn and apply in their countries many of the advances in fertilizer production, marketing, and use of the United States. ■

Upcoming Training Programs

Program	Location	Dates
IFDC Headquarters		
Fertilizer Marketing		
Fertilizer Marketing Management Training Program	IFDC	August 12-September 20, 1985
Fertilizer Sector Development in Tropical and Subtropical Agriculture	IFDC	June 16-July 25, 1986
Use of Microcomputers for Fertilizer Sector Personnel	IFDC	July 28-August 8, 1986
Fertilizer Marketing Management Training Program	IFDC	August 11-September 19, 1986
Quality Control of Fertilizer Products	IFDC	September 22-October 3, 1986
Fertilizer Production and Technology		
Maintenance and Production Management Training Program	IFDC	September 30-October 18, 1985
Fertilizer Production Process Economics Training Program	IFDC	May 5-16, 1986
Maintenance and Production Management Training Program	IFDC	October 13-31, 1986
Regional Programs		
Fertilizer Efficiency Research in the Tropics for Asian Region	Indonesia	November 18-December 6, 1985
Fertilizer Marketing Training Program for Asian Region	Singapore	December 9-20, 1985
Fertilizer Distribution and Handling Training Program	India, Singapore, Indonesia	February 17-March 7, 1986
Fertilizer Marketing Training Program for Africa	Kenya	March 17-28, 1986
Statistics and Economics of Fertilizer Use (in Spanish)	Colombia	November 3-28, 1986
Fertilizer Marketing Training Program for Asia	Indonesia	December 8-19, 1986
Fertilizer Efficiency Research in the Tropics—Africa (in French)	Ivory Coast	October 20-31, 1986

NOTE: Dates are subject to change.

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IFDC is a public, nonprofit organization dedicated to increasing food production through the development of new and improved fertilizers and fertilizer know-how for developing countries.

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