IFDC

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

Headquarters—

USG Dispenser Developed for Hand Deep Placement of Urea During Rice Transplanting

The overriding goal of all of IFDC's research is to produce technology that is applicable to developing countries and affordable by their farmers. Part of this goal may come to fruition in the form of an apparatus to be used by rice farmers in urea fertilizer application.

An inexpensive, light-weight, simple-in-design, durable, and yet effective dispenser with transplanting guide has been developed by IFDC to facilitate hand deep placement of urea fertilizer as urea supergranules (USG) at the time of rice transplanting.

In several national and international field trials conducted in Asia and Southeast Asia, deep placement of USG has been proven efficient in increasing rice yields or reducing nitrogen requirements. This is mainly because it not only decreases nitrogen losses (caused by ammonia volatilization, denitrification, and runoff) but also improves the availability of urea nitrogen to rice plants. However, until now, this effective urea use technology has not been transferred to rice farmers. This is partly because the present practice of deep placement of USG that is carried out a few days after transplanting is very labor intensive. Moreover, in randomly transplanted rice paddies, which are still quite common in many developing countries of Asia, it is impossible to uniformly deep place USG by hand. While attempts to develop machines for deep placement of USG continue, IFDC realizes that some intermediate technology is urgently needed for small-scale rice farmers who may want to apply small doses (30-50 kg N/ha) of USG to increase their grain yields.

In an integrated approach launched by IFDC, a USG team consisting of rice agronomists, soil scientists, economists, and chemical engineers and headed by Dr. Paul J. Stangel, Deputy Managing Director, started its work. Dr. Narayan K. Savant, Soil Scientist of the USG team, has been researching the chemistry and fate of urea at deep placement sites. Savant developed a prototype wooden USG dispenser with a transplanting guide (Inset, Figure 1) at IFDC Headquarters. Recently, the prototype has been modified by Savant, while working in collaboration with Prof. R. V. Jadhav, Agricultural Research Engineer, College of Agriculture, Pune, India (a regional institution of Mahatma Phule Agricultural University, Rahuri). They have now fabricated a modified USG dispenser with a transplanting guide made of bamboo and other locally available materials (Figure 1). A modified dispensing lever with an agitator fabricated by Prof. Jadhav has improved its operation.

"Use of the dispenser with a transplanting guide is very simple," Savant said.

In a recently puddled field ready for transplanting, two transplanters stand on either side of the dispenser. Using the transplanting guide, each worker transplants two rows, each one consisting of 10 or 12 rice hills. The dispenser has a simple provision for adjusting distances between and within rows. By lifting the dispensing lever for a second, the transplanter can transfer five to ten USG into the wire basket located below the USG hopper. Then each transplanter picks up five or six

Indian field workers use the USG dispenser in a rice paddy at transplanting time.

USG and places one USG in the center of four rice hills, alternately."

In a freshly puddled field, the holes at USG placement sites may close automatically, or the transplanters can cover them immediately and very easily. After the combined operation of transplanting and deep placement is over, one of the transplanters pushes or shifts the dispenser backwards, aligns the transplanting guide with the already transplanted line, and repeats the operation until the whole field is covered.

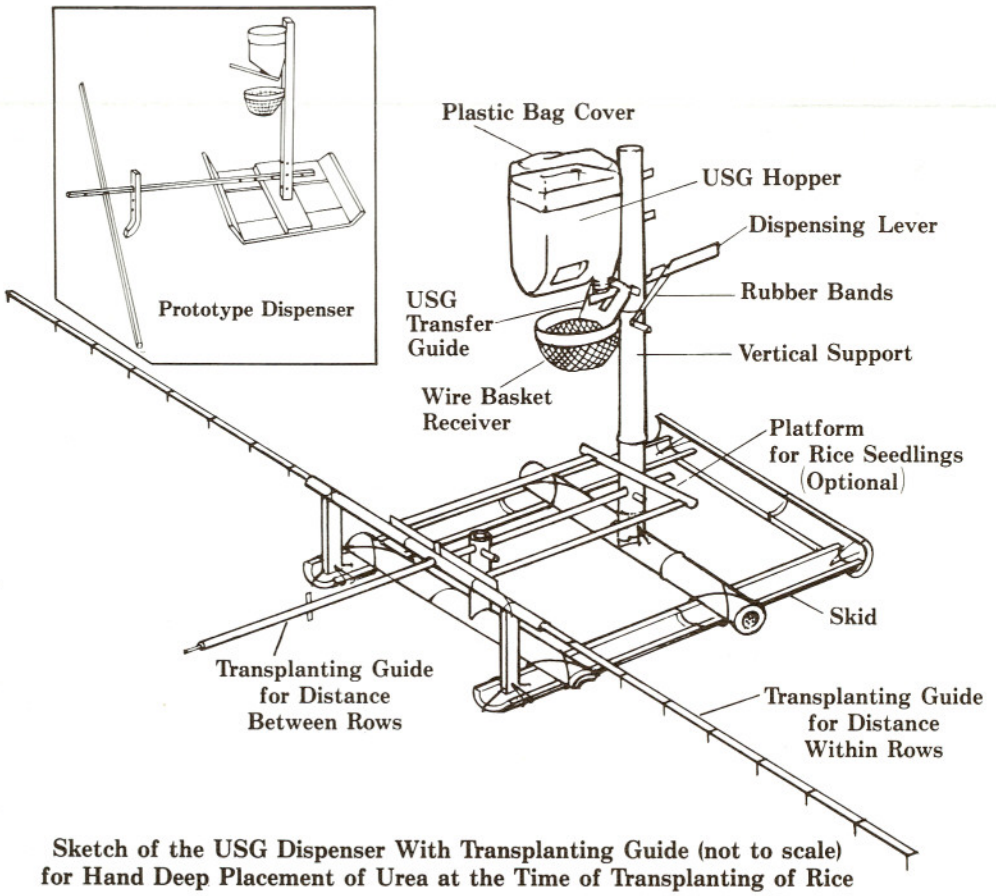
During the 1985 wet (Kharif) season in India, this procedure was used to conduct field evaluation trials of the dispenser with a transplanting guide. The results of these preliminary trials suggest that by using the apparatus for transplanting and hand deep placement, labor required for deep placement can be reduced by 40% or more of that required for the deep placement done a few days after transplanting.

There are other important benefits of using the dispenser. The USG is well protected from rain and floodwater in the field. A small-scale rice farmer can follow an efficient management practice of deep placement of urea with his own limited available labor. Transplanted seedlings are not disturbed. Additionally, the apparatus can help to expand in-line transplanting.

"If proper training classes and village-level demonstrations are organized, I am hopeful of the dispenser's acceptance by rice farmers because it is inexpensive (US $3-$3.5) and still effective," Dr. Stangel said.

Because it is simple in construction, it can be fabricated and repaired by local carpenters. Its bamboo construction makes it light weight (2.5 kg) and durable. With minor adjustments it seems to work well under highly variable agroclimatic conditions. Uncoated USG of any shape can be used.

As a result of combining two operations—hand deep placement of USG and transplanting—it may now be possible to expand hand deep placement to a larger spectrum of rice farmers. IFDC has plans to conduct more trials and demonstrations on farmers' fields to transfer this improved USG use technology to the small-scale rice farmers, especially in Asia. However, the USG dispenser represents one component of a 2-part technology needed to transfer hand deep placement to developing-country rice farmers. The missing link is an affordable village-level briquetter for producing USG. The chemical engineers of IFDC, in collaboration with other groups, are now planning to develop a small-scale machine or briquetter for making USG at the users' level. This briquetter can be a modification of a village-level briquetter developed by the Fukien Academy of Agricultural Sciences, People's Republic of China. If this is done, USG at a reasonably low price will be available to the rice farmers, and IFDC will be able to transfer a complete package of production and use technology to the developing countries for increasing overall rice production.■



Sketch of the USG Dispenser With Transplanting Guide (not to scale) for Hand Deep Placement of Urea at the Time of Transplanting of Rice

IFDC In The Field

India—

Change in Timing of Fertilizer Application Produces Higher Yields

A recently completed 2-year research program on irrigated wheat in the Punjab—the bread basket of India—has shown that Indian farmers can gain 23% more yield by applying nitrogen fertilizer before rather than after irrigation.

Indian field workers involved in the ICAR/IFDC project take soil cores from ^{15}N-treated microplots.

With funding from the United Nations Development Programme and the Indian Council of Agricultural Research (ICAR), IFDC conducted this research project in cooperation with ICAR at the Punjab Agricultural University (PAU) of Ludhiana, India. IFDC and ICAR/PAU conducted these collaborative experiments from 1982 to 1984 on irrigated wheat grown on heavily percolating, light-textured soils.

According to Dr. Jagdish Katyal, IFDC Soil Scientist, the major objectives of these experiments were to determine the effect of timing of fertilizer application relative to irrigation and the effect of source of fertilizer nitrogen on its use efficiency and on losses of nitrogen.

The nitrogen fertilizers that were used in the experiments included urea, urea-DCD (a nitrification inhibitor), urea-PPD (a urease inhibitor), and potassium nitrate. Urea is the principal nitrogen fertilizer used in the Punjab. Potassium nitrate was included to test whether leaching of nitrates (or denitrification) would be a major nitrogen loss mechanism in these soils.

All fertilizers were split-applied; the basal application was broadcast and incorporated after an initial irrigation, and the topdressing was applied either after or before irrigation.

"Prior to our research, the locally recommended practice in the Punjab for topdressing fertilizer was to apply fertilizer nitrogen to heavily percolating, light-textured soils after irrigation," Katyal said. "It was thought that if fertilizer were applied before irrigation, the fertilizer would be pulled down (leached) into the soil and the plant would not be able to make use of it. We wanted to test this theory."

The researchers found that leaching was not a problem when fertilizer nitrogen was applied before irrigation to heavily percolating, light-textured soils such as those of the Punjab. Besides being more convenient to apply the fertilizer prior to irrigation—it is easier to walk on dry soil than wet soil—23% more yield is produced than when fertilizer is applied after irrigation. This amounts to about 800 kg of extra wheat per hectare.

"Our research also proved that denitrification is not a problem as was previously thought," Katyal said. "The major loss mechanism was found to be ammonia volatilization, particularly if the fertilizer is broadcast on the surface of wet soils."

By broadcasting the fertilizer and then irrigating the fields, the researchers could reduce ammonia volatilization. When the water moves down into the soil, the fertilizer moves along with it and gets placed deep into the soil where it is protected from ammonia volatilization. If fertilizer is applied after irrigation, it stays on the surface and ammonia volatilization can take place since the fertilizer is not placed beneath the surface.

"In our experiments losses of nitrogen were reduced from about 40% to 18% when urea was topdressed before rather than after irrigation," Katyal said. "If these results apply to all of the Punjab, more than US $24 million worth of nitrogen fertilizer could be saved by simply applying the urea before irrigation rather than after."

The application of potassium nitrate gave the highest yields in the experiments regardless of whether it was applied before or after irrigation. Grain yields in treatments where urea-PPD was applied after irrigation were higher than where urea or urea-DCD was applied after irrigation.

IFDC intends to continue research on cereal crops grown under irrigated conditions in semiarid regions. The emphasis in this research will be on the interaction between water and fertilizer management. ■

Headquarters—

RESEARCH CONDUCTED BY TUNISIAN MAY HAVE IMPLICATIONS FOR OTHER COUNTRIES

Collaboration with universities on the international level has always been an integral part of IFDC's research program. An example of this cooperation occurred recently with a Tunisian university.

Dr. Salah Salem Romdhane, a professor of chemical engineering at the École National d'Ingenieurs of Gabes, Tunisia, asked to come to IFDC to participate in a phosphate research program that should have implications for the fertilizer industry of his country and possibly others.

(Continued on page 5)

Kenya—

Team Lays Groundwork for Fertilizer Marketing Plan

Kenya—the name conjures up visions of wildgame reserves and rich green fields of tea and coffee plantations in the highlands of the southwest. Yet, less than 20% of Kenya's land is potentially arable. With much of that land already densely populated, foodcrop production faces serious constraints.

The Government of Kenya has undertaken a program to revitalize the agricultural sector through more responsive and realistic producer prices and more efficient marketing. Building a strong fertilizer sector is an integral part of Kenya's long-range plan to establish a viable agricultural program. In this light, a study recently conducted by an IFDC team in Kenya should help that country in developing a more efficient fertilizer marketing system.

The team recommended that Kenya develop an overall master plan for building a viable fertilizer industry and make long-term plans for the allocation of fertilizer to distributors so that they can determine and justify infrastructure required for effective marketing. They also recommended that Kenya select distributors for USAID fertilizers who can meet established criteria for fertilizer marketing, for example, by providing educational programs and making fertilizers available to small farmers.

IFDC was commissioned by the U.S. Agency for International Development (USAID) through the IRI Research Institute, Inc., to evaluate USAID's Agricultural Development Program in Kenya. A marketing team, composed of L. B. Williams and J. H. Allgood, visited Kenya in July 1985 to study the USAID program. The principal objectives of the program are to promote widespread distribution of fertilizer through involvement of the private sector, make fertilizers timely available to small farmers, and increase the use of fertilizers by small farmers.

The USAID program focuses on a number of specific issues (for example, pricing, product distribution, timeliness of supply, and increasing competition), which are critical to increasing agricultural production. Although the program is only 1 year old, significant progress has been made in improving Kenya's fertilizer situation in the short term.

"We surveyed all of the distributors of USAID fertilizers," Williams said. "We determined the amount requested, amount received, and the marketing program that was used to help meet the overall objective of the USAID program. We found that USAID through its donation of diammonium phosphate fertilizer has significantly increased the use of phosphate in Kenya."

"We learned that the actual effective demand for fertilizer has never been established," Allgood said. "In recent years shortages of fertilizer supply appear to have limited fertilizer use."

Since there has been no continuity in the allocation of fertilizer to the marketing organization, the infrastructure necessary for effective marketing has not been established.

"The study team determined that a master fertilizer marketing plan is needed to guide those influencing the fertilizer sector including donors, marketing organizations, and suppliers. The master plan will include the type of marketing organization that will be most effective for Kenya." Williams said.

The USAID/Kenya mission has started implementing the study team's short-term recommendations. Further, USAID/Kenya is considering study recommendations that will have a long-term positive impact on Kenya's fertilizer sector and, hence, agricultural production. ■

Above: John R. Thomas (left), Deputy Chief, Agriculture, USAID/Kenya, and the IFDC marketing team members—J. H. Allgood and L. B. Williams—examine a maize crop in Kenya.

Left: A Kenyan field worker harvests tea near Kericho.

Tunisian Conducted Research
(Continued from page 3)

Tunisia is expanding its phosphate fertilizer production base, and as it does so, it has found it necessary to use a wider range of rock sources including some of lower quality. Phosphoric acid made from this phosphate rock is being used in Tunisian fertilizer plants to produce diammonium phosphate (DAP), which has become the most popular phosphate fertilizer because of its high analysis, high availability, and good physical properties. Maintaining these good chemical and physical properties becomes more difficult with the use of phosphate rocks of lower quality.

With support from the Academy for Educational Development, Washington, D.C. (U.S.A.), Dr. Romdhane, participated in a research program at Headquarters on the problems associated with the use of low-quality rock. Romdhane came to IFDC for two periods of training, first during April-June 1984 and later during April-June 1985. The purpose of Dr. Romdhane's training program was to learn the technical skills needed to provide support to the Tunisian fertilizer industry.

"I had the chance to interact with IFDC/TVA staff involved in this work," Romdhane said. "My main interest was examining DAP samples prepared from commercial phosphoric acids with various types and levels of impurities. My work concerned the identification of water-insoluble compounds that are formed because of the impurities in the acids."

Romdhane has learned the necessary techniques; he can now interact with the Tunisian fertilizer industry to try to solve its problem. The next phase of the work is to see how these insoluble compounds can be minimized or avoided during processing. Romdhane will continue this portion of the work in Tunisia; at the same time, IFDC will also be trying to identify the process technology that will prevent or minimize the formation of water-insoluble compounds. ■

Nigeria—

DUAL FERTILIZER MARKETING STUDY COMPLETED

In early 1985 at the request of the Federal Republic of Nigeria, IFDC sent two teams of marketing and distribution specialists to that country to conduct commercialization and transportation studies of Nigeria's fertilizer sector. These teams have made their recommendations, and Nigerian officials have begun their implementation. (Each of these studies is discussed below.)

New Fertilizer Marketing Plan to Reap Variety of Benefits

When the Government of Nigeria implements the commercial fertilizer marketing plan developed by IFDC, that country should begin to reap significant benefits as a result, according to a final project report to the Government of Nigeria.

The recommended commercial fertilizer marketing system is designed to increase fertilizer consumption, which is needed to increase food production. Through the use of local resources, the plan will enhance the national economy by increasing agriculture's contribution. The system will save foreign exchange, help to increase employment, and upgrade technical expertise.

At the request of the Federal Republic of Nigeria, a team headed by L. B. Williams, Regional Coordinator—Africa, visited Nigeria in January 1985 to conduct a feasibility study for commercializing fertilizer marketing in Nigeria. The study was expected to outline and describe an organizational structure and all component parts required for efficient operation. The study was also to provide for phasing in the system and identify institutional linkages required for efficient operation of the system.

"The recommended marketing system will give first consideration to production from the Onne plant now under construction," Williams said. "It will also determine and import any additional products that may be needed. The system will allow the collection of data necessary to determine and monitor marketing costs."

The Government of Nigeria is aware that the current cost of marketing fertilizers in Nigeria is high and has become a burden on the country's economy. In earlier years when consumption was small and oil revenues were high, the drain on foreign exchange and other needed national programs could be managed. In 1984 with the importation of 751,000 tonnes of fertilizers, the direct cost to the Nigerian Government exceeded 90 million naira (US $125 million). Thus, the Government of Nigeria considered the possibility of discontinuing its direct involvement in the fertilizer business by creating a self-supporting commercial organization that would increase fertilizer consumption, help to make farmers aware of the proper use of fertilizers, and increase food production in Nigeria. The new fertilizer marketing system is designed to cause the commercial organization to become a reality, provided the system is implemented by the Nigerian Government.

"The new system is to be a centrally managed, autonomous organization having profit and loss responsibilities," Williams said. "It is designed to market 1 million or more tonnes of fertilizer. The Government will determine the policies of the company but leave the execution of these policies to the commercial fertilizer company. The study recommends that the commercial system be phased in during a 4-year period."

It is projected that the total savings during 1988 will be 74.9 million naira (US $104 million). Of this, 55.9 million naira (US $82 million) can be attributed directly to the recommended marketing system as a result of increased efficiency and larger sales. The savings due to the new system can increase annually as the marketing system matures.

Fertilizer Transportation and Storage Optimization Study Conducted

At the request of the Federal Ministry of Agriculture, Water Resources and Rural Development, a transportation team headed by Dr. W. E. Clayton, Transportation/Distribution Specialist, studied Nigeria's port handling, transportation, and storage of fertilizers. The team developed plans for more efficient distribution of fertilizers from imports and from local production to approximately 2,000 sales points.

As a result of the study, a cost-effective distribution system was recommended that would use the most effective modes of transporting fertilizer in Nigeria—trucks and railroads—and a point-of-sale warehousing scheme to support the recommended commercial fertilizer marketing system.

"After personnel costs the largest cost component of marketing is that associated with distribution," said Dr. V. L. Sheldon, Marketing Specialist and a member of the team commissioned to study Nigeria's fertilizer distribution system. "If you can make fertilizer distribution as efficient as possible, you can substantially reduce the cost of fertilizer to the farmer," he said.

A Nigerian woman sells yams at a farmer's roadside market. In Nigeria most of the crop harvesting and marketing is carried out by women.

"The distribution system is composed of several components, including modes of transport, warehousing, handling procedures, seasonality, fertilizer use, tonnages required, and destination of shipment. In conducting the study, we determined the actual physical movement of the fertilizer products," Sheldon said. "We audited the seasonal sales forecasts, inventory management, packaging, and order processing systems and made recommendations for improvements in these areas. We advised the Federal Government of Nigeria on a system to improve the efficiency of that movement and thus lower the costs of marketing."

By implementing the recommendations of this study, Nigeria will be improving the use of its railway mode and establishing transshipment centers for more effective movement of fertilizer product. Fertilizer should be made more readily available to the small farmer of Nigeria and at less cost to both the farmer and the Government.■

Headquarters—

FEPIS Provides Unique Service

Would you like to grow a crop on a computer? Would you like to predict in advance what the most probable agronomic and economic performance of certain fertilizer products and management practices will be when they are used on a particular crop under a given set of soil and climatic conditions?

This is one type of information that researchers at IFDC are now developing through a new program called "Fertilizer Evaluation Program and Information System (FEPIS)." Through FEPIS, IFDC aims to generate information on the agronomic and economic performance of fertilizer products and practices and on the use of these fertilizer technologies under uncertainty. For example, with minimal data, comparisons of various fertilizer products can be made, and benefit/cost ratios can be derived for a variety of fertilizer products and management practices. The data sets to permit this type of analysis are being derived from IFDC field programs and collaborative research.

The program will make this information available to researchers and decision-makers throughout the national and international organizations involved in agricultural research and development. This program is designed to also provide advisory services and training on data analysis, fertilizer evaluation methodologies, statistical and economical analysis, crop modeling techniques, and fertilizer-related research planning. The FEPIS program will enhance the benefits of the Center's research to developing countries by providing data that are useful for the design of sound fertilizer policies and fertilizer use strategies in these countries.

"To achieve these objectives, the program was established with three main components," Dr. Paul L.G. Vlek, Director of the Agro-Economic Division, said. "These components include a fertilizer database system, data analysis and modeling services, and fertilizer efficiency information system."

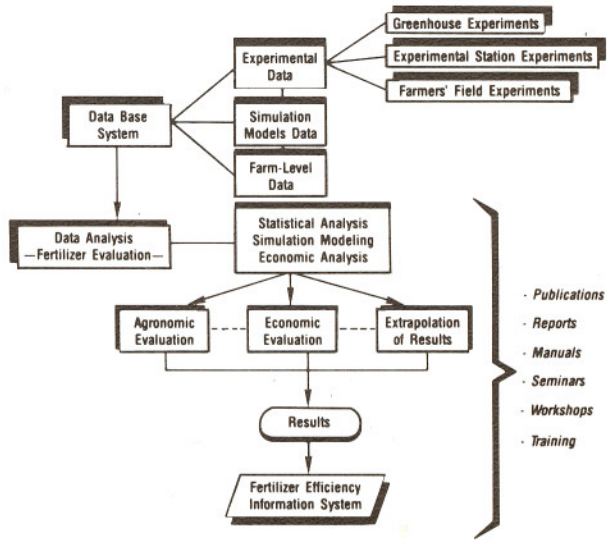
The coordinator of the FEPIS program is Dr. Carlos A. Baanante, Economist. Other FEPIS staff members include Dr. Douglas C. Godwin, Agronomist/Systems Modeler and Dr. Julio Henao, Agronomist/Biometrician. The FEPIS team also includes computer programmers and data processing specialists.

"We have provided statistical and economic analysis and data processing services for field experimentation studies in nitrogen efficiency and phosphorus management for the following African countries: Togo, Sierra Leone, Burkina Faso, Nigeria, Niger, Mali, Senegal, Kenya, Gambia, Cameroon, and Liberia," Dr. Baanante said.

The FEPIS team has also conducted statistical and economic analyses using results of field experiments and research on the use of indigenous phosphate rock resources in Colombia. They have provided advice on data analysis and experimental design for experimentation on nitrogen efficiency studies in the Philippines. The team also provided technical assistance to the Government of Ecuador in training of field technicians and in planning and executing field trials.

If you or your organization is interested in the services of FEPIS, please contact Dr. Paul L.G. Vlek, Director, Agro-Economic Division, IFDC.■

Components of the Fertilizer Evaluation Program and Information System



Training Program Activities

Headquarters—

NINTH ANNUAL PROGRAM TRAINS MARKETING MANAGERS

"If I can adopt these skills I am sure I'll be a better manager when I return to my company." These were the words of one participant—D. Ganapathy of Madras, India—during an interview at the conclusion of the ninth annual Fertilizer Marketing Management Training Program held at Headquarters recently.

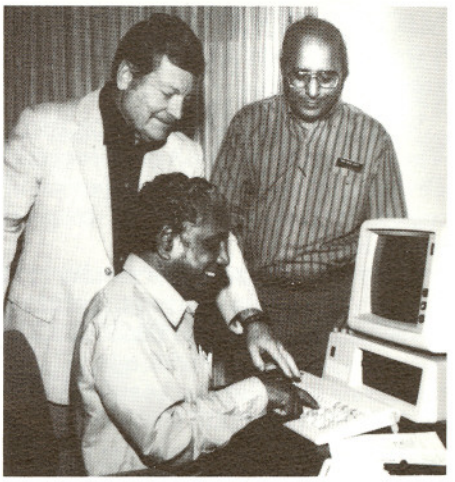
Ganapathy was referring to skills that he acquired during one of the major activities of the program—Effective Management Communications. The 23 participants from ten countries were exposed to a variety of activities designed to mold them into skilled fertilizer marketing and management personnel.

This 6-week program, which began on August 12 and concluded on September 20, also covered such topics as the marketing function and its elements. Factors influencing marketing decisions were addressed and included agronomics and economics of fertilizer use, government policy, fertilizer product characteristics, and product packaging and handling. The group was introduced to microcomputers for management's use in information development and decisionmaking.

The program was presented by a core of IFDC staff with support from selected specialists from the National Fertilizer Development Center of the Tennessee Valley Authority, other international organizations, universities, cooperatives, and the fertilizer sectors of developed and developing countries. These faculty members made a lasting impression on the program participants. Ganapathy put it this way: "First of all, I was most impressed with the people at the Center from the leader to everybody else. Everyone was very helpful to us in every way."

Ganapathy came to fertilizer marketing by way of agricultural communication. "I was originally a radio farm broadcaster," he said. "My present job involves managing the promotional activities for my company, Madras Fertilizers Limited. As manager of market development, I am involved in advertising, publicity, and field promotions."

"I manage people in the field and organize training programs for them. I am still actively involved in agricultural communication; once a month I produce an agricultural program for television and radio. This program gives advice to farmers on new practices and varieties that will increase their yields."



D. Ganapathy (foreground), an FMMTP participant, enters information on a microcomputer; he is assisted by Dr. R. T. Smith and R. S. Giroti.

Ganapathy plans to relay some of the information that he learned during the marketing training program to his audience in India.■

Upcoming Training Programs

Program	Location	Dates
Headquarters		
Fertilizer Marketing		
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		
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.

Recent IFDC Publications

MICRONUTRIENTS IN TROPICAL FOOD CROP PRODUCTION

This publication, edited by Dr. P.L.G. Vlek, Director of the Agro-Economic Division, is an up-to-date appraisal of micronutrient research in tropical agriculture.

The book contains the results of a survey of the micronutrient problems of 20 tropical countries. The 10-chapter monograph also includes related contributions from various internationally known micronutrient specialists.

This latest IFDC technical bulletin provides a background for scientists of developing countries so that they can mirror their own accomplishments against those of other tropical countries.

Interested parties in developed countries should order the book from Martinus Nijhoff, Spuiboulevard 50, P.O. Box 163 AD Dordrecht, The Netherlands. A limited number of copies are available for purchase by developing countries; these may be ordered directly from IFDC by requesting technical bulletin T-30 and sending US $15.00 to the IFDC Purchasing Department, P.O. Box 2040, Muscle Shoals, Alabama 35662.

FERTILIZER SITUATION IN THE ARAB REGION

This publication was cosponsored by the Arab Federation of Chemical Fertilizer Producers. The reference manual includes data on production, consumption, imports, and exports for several fertilizer products, raw materials, and intermediates, including natural gas, ammonia, urea, ammonium sulfate, phosphoric acid, etc.

To order this publication (reference manual R-5), please send your request and US $100 to the IFDC Purchasing Department, P.O. Box 2040, Muscle Shoals, Alabama 35662.

IFDC ANNUAL REPORT, 1984

IFDC has just released its Annual Report covering the 1984 activities. This publication, commemorating the Center's Tenth Anniversary, recounts the progress made in four programs areas—research, national programs, technical assistance, and training. Dedicated to the internationally known fertilizer expert, Travis P. Hignett, this volume contains 56 pages covering the Center's latest advances in the production and use of fertilizer for the developing countries, especially the tropics and subtropics.

To order this free publication, please request Circular S-8.

IFDC Report

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