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Centro International de Agricultura Tropical

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The year 1976 saw a continued maturing of the various programs of CIAT which enabled them to progress along the lines of both their immediate- and long-range goals; in turn, the overall objectives of the Center also benefited from these advances. CIAT, therefore was able to significantly strengthen its attack on food production and productivity problems with research and international cooperation work throughout its special region of interest — Latin America and the Caribbean.

Highlights of the work are briefly described in this report. In most cases the work reported is of concrete accomplishments, as opposed to preliminary findings which will be rechecked or confirmed in the future. The general thrusts of the work may be classified into three categories of endeavors that underlie the majority of projects at CIAT.

First, the Center aims to utilize natural agricultural resources to the maximum extent possible. This is reflected in the decision that the Beef Program concentrate on developing new technology to increase production on the under-utilized resource of the acid, highly infertile soils covering vast areas of Latin America. Similarly, efforts to collect, evaluate and conserve the important genetic resources of *Phaseolus* beans, various tropical forages and cassava are other aspects of this objective.

Secondly, much of CIAT's research efforts are directed to developing a minimum input philosophy. There are various reasons for this, ranging from the small farmer's inability oftentimes to buy inputs that would assure satisfactory yields to the world-wide scarcity of certain products. Insect and disease problems can often be solved through genetic resistance, through changing cultural practices or through natural control factors. Plants can be selected and bred that are less demanding of certain nutritional elements or that are adapted to difficult soil conditions. All of these obviate in some degree the need for purchased inputs. This minimum input philosophy does not preclude the use of inputs when they are necessary to provide optimum yields under given conditions, however, the goal is to limit their use if better methods of production can be found.

The third characteristic of CIAT's work is that of continued expansion of its outreach activities whenever possible. Prime examples of this activity are the several international networks of research cooperation or assistance and germplasm testing. Training and conference activities and information dissemination are other ways of fulfilling this important function.

The Bean Program's chief product is germplasm. This may be supplied to client national programs as a promising source of disease or insect resistance; as hybrid material with nationally important varieties already crossed to the resistance source; as late generation "elite" materials previously screened at CIAT; or as formed varieties from CIAT or other national programs.

Highlights of the program's activities during 1976 point out several approaches being employed to assemble, evaluate, produce and make available the bean germplasm needed by national programs.

In 1976 CIAT accepted the primary responsibility from the International Board for Plant Genetic Resources to maintain and characterize germplasm of *Phaseolus vulgaris* and related species important as sources of factors for improving the common bean. To that end the Bean Program continued its collecting and evaluating of germplasm from throughout the world and further developed its plans for managing the collection. The *Phaseolus* collection at CIAT now contains more than 14,000 accessions.

As soon as meaningful results are available from evaluations, attempts are made to get this information to potential users. During the year, a detailed catalog of 781 promising cultivars identified from these evaluations was published and distributed to breeders in national programs and to other interested workers and cooperators. The book provides evaluation data for up to 50 characters for each promising accession.

A detailed catalog describing 781 CIAT-selected, promising accessions of *Phaseolus* beans was distributed throughout the world.

Also during the year the first International Bean Yield and Adaptation Nursery was assembled and distributed to workers in 30 countries. Ninety sets of this nursery were sent. The accompanying table shows the countries which received the nurseries.

Testing at the international level to identify sources of resistance to important bean diseases also increased in 1976.

The second international bean rust nursery was tested in 14 locations. Results from the first collaborative nursery showed three cultivars were resistant to rust in all six testing locations. Two of the three cultivars, Countries cooperating in the first International Bean Yield and Adaptation Nursery trials.

Country	No. of sets dispatched	Country	No. of sets dispatched
Latin America and the Caribbean		*North America and Europe*	
Belize	1	Canada	1
Bolivia	3	Russia	1
Brazil	15	United Kingdom	2
Colombia	8	United States	2
Costa Rica	1	Yugoslavia	1
Chile	4		7
Dominican Republic	4		
Ecuador	5		
El Salvador	5	*Africa, Asia and Oceania*	
Guatemala	3		
Haiti	1	Iran	1
Honduras	4	Israel	1
Mexico	4	Japan	2
Nicaragua	3	Malawi	1
Panama	1	Philippines	1
Peru	4	Tanzania	4
Trinidad	1	Thailand	2
Venezuela	4		
			12
	71		
		Total	90

The first International Bean Yield and Adaptation Nursery was assembled and sent to cooperators in 30 countries.

P599 and P717, have been used as primary sources for rust resistance in breeding work within the CIAT Bean Program.

An international nursery for bean golden mosaic virus, consisting of 80 selections, was assembled and sent to four countries. Early results indicated that some promising materials were tolerant to the virus strains present in both Central America and Brazil.

Activities in the Latin American Bean Research Network, for which CIAT is responsible, were strengthened and enlarged in 1976. The accompanying map shows the locations and types, including some of the trials reported above, of collaborative activities in which the program participated.

Locations and types of collaborative activities undertaken in Latin America by the CIAT Bean Program in 1976.

Experiments to find practical means of ensuring seed free of pathogens, which are frequently carried over into new plantings, indicated that the time of harvest appears to be extremely important in producing high-quality seed. Delaying the harvest can result in reduced germination and field emergence, and increased seed infection by fungi. In addition, seed saved for future planting, which is harvested from pods in contact with the soil, does not germinate well and may carry higher numbers of internal seed-borne fungi. Selective harvesting techniques are important for small farmers who commonly save seed from one harvest to another.

Nitrogen fixation rates as high as 41 kilograms of nitrogen fixed per growing season were obtained when specific varieties of beans were inoculated with efficient strains of *Rhizobium* in favorable ecologies. The table shows how beans rank among several grain legumes in fixation capacity.

Climbing cultivars such as P590 have been consistently higher in nitrogen

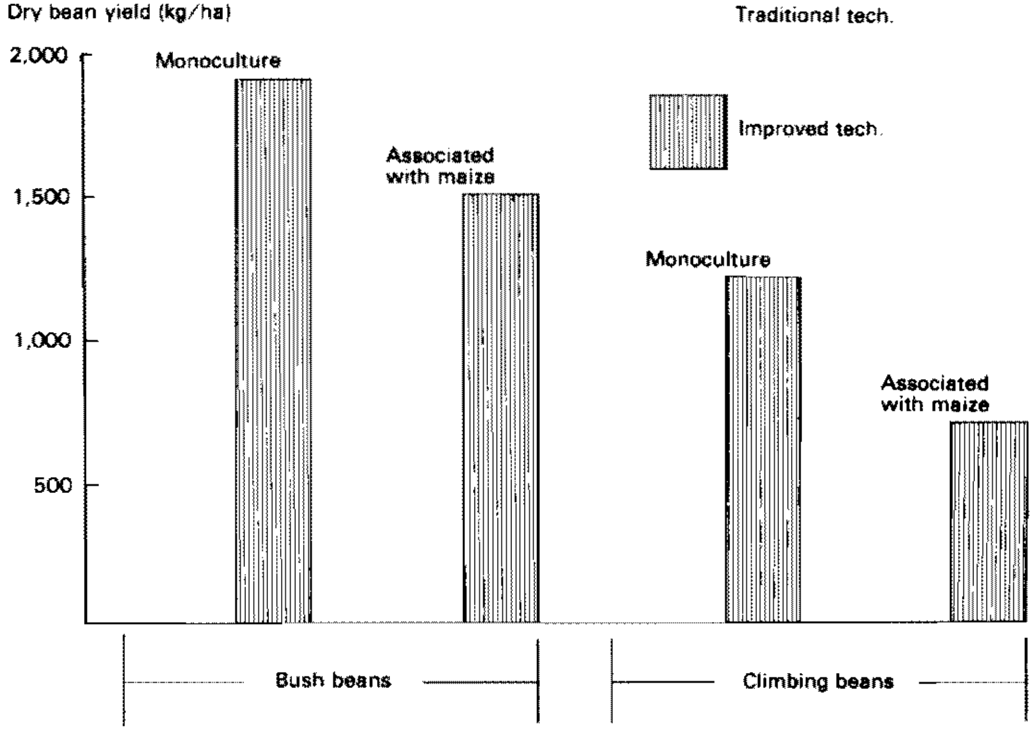
Representative nitrogen fixation rates in some common grain legumes (data taken from various sources)

Legume	Nitrogen fixed (kg/ha/year)
Common bean (accession P590)	82
Common bean (20 cultivars)	50-60
Soybean	57-94
Peanut	35
Cowpea	95
Common pea	25

fixation than have bush cultivars, the differences apparently being related to different patterns of carbohydrate storage and distribution. Experiments showed that cultivars fixing the most nitrogen tended to maintain more of their carbohydrates in soluble forms enabling easy translocation within the plant, including movement to the nodules. A hybridization program was initiated to breed for improved nitrogen fixation in commercial cultivars.

Extensive experimentation at CIAT on bean/maize intercropping systems and evaluations of suitable bean germplasm for such systems produced bean yields of 2.1 ton/ha of dry beans associated with 4.9 ton/ha of maize. When fertility and moisture were not limiting, maize yields were not reduced due to the association with beans.

Testing of intercropping systems on small farms in one area of Colombia



On-farm yields of bush and climbing beans at Restrepo, Colombia under two planting systems and two levels of technology.

Experiments on small farms in one region of Colombia confirmed that technology packages involving simple but improved practices could produce more beans than traditional systems. The trials were in cooperation with the Colombian Coffee Growers' Federation.

showed that yields from traditional systems can be significantly improved using only limited additional inputs and improved technology, including increased planting density, a granular insecticide at planting and a low level of chemical fertilizer. The graph compares the yield differences obtained between traditional and improved technology.

In 1976, the numbers of new parents and the new crosses increased substantially. Cumulative figures for four important resistance factors being incorporated or sought in parental lines and being introduced into progeny lines are shown in the table. These breeding activities support the short-term goals of the Bean Program for stabilizing bean yields under farmer conditions by developing resistance to the most important diseases and insect pests.

Building on work from the various disciplines, workers in the Bean Program defined four ideotypes for beans to be developed and bred to meet the program's long-range goals. The four will provide bean types for the different classes of farming systems

Cumulative number of parents and hybrid progenies with single and multiple resistance factors assembled in the CIAT Bean Program during 1974-76.

	Common mosaic	Rust	Anthracnose	*Empoasca*	Two factors	Four factors	Total
Parents							
1974	5	2	1	5	5		10
1975	16	15	11	31	16	-	100
1976	28	20	22	47	24		178
Progenies							
1974	16	8	2	16	-	0	20
1975	433	279	165	461		21	835
1976	1,501	1,273	786	1 841		192	3,482

found in Latin America where the crop is commonly grown under varying conditions.

Type A will be for short growing seasons, with a maturity of about 75 days. The plant would have to tolerate high planting densities, and because of the short maturity, could be expected to yield about 2.5 ton/ha.

Type B will be for high-yielding commercial conditions where technology levels will be high and environmental conditions are good.

Type C is to be the ideotype for variable growing conditions and/or low technology. The plant would have the capacity for stable yield under difficult growing conditions and the ability to respond when growing conditions are favorable.

Type D is the ideotype for planting in association with maize. It would be a strong climbing type with capacity for high yields.

Thirty-eight professionals trained in the Bean Program during the year.

The development of many aspects of cassava production technology has now reached the stage when it can be used by farmers with only minor changes to adapt it to regional conditions. Much of this technology is rather simple; CIAT scientists have amply demonstrated that farmers can increase their cassava yields on the order of two or three times the average yields for large areas or even countries by using not more than low or modest levels of inputs. While major emphasis is still directed to developing new technology, including high-yielding hybrids that incorporate disease and pest resistance, increased efforts are being directed to training and cooperative projects with agencies in many countries.

The outstanding cassava line M Col 1684 showed exceptional yield stability in replicated trials over a range of conditions. At CIAT it produced more than 50 ton/ha; at Caribia, 44 ton/ha; and, at Carimagua, 36 ton/ha. Soil conditions at these sites ranged from infertile to highly fertile with pH's from 4.5 to 7.8. Mean temperature range was from 24° to 28°C. Most cassava grown in the world is within these environmental ranges. These results suggest not only that cassava can be grown successfully under a wide range of environments, but also that a single high-yielding genotype can be utilized over the major portion of this range.

Especially promising was the yield of 36 tons at Carimagua, where the crop received only modest levels of fertilizer. This confirmed the excellent potential of cassava for low fertility conditions. At Carimagua most other food crops require considerably more fertilizer inputs to produce acceptable yields.

In regional yields for testing newly-selected lines, lines selected from the CIAT germplasm collection continued to perform well. These trials are con-

Field days on farms associated with the Colombian Coffee Growers' Federation have proven extremely helpful in showing differences between traditional and improved methods of producing cassava. The farms are located in an important cassava producing area of Colombia.

At the end of the field days, farmers (and sons) are allowed to take a few stakes of promising cassava lines home to plant — an ideal way to observe improved plant materials.

ducted under technology which stresses low cost inputs which farmers can readily accept. Among trials in nine locations, the best promising line at each site yielded an average of 26.8 ton/ha, more than three times the national average yield of about 8 ton/ha in Colombia.

Average yields of the best local lines at the nine sites were 16.3 ton/ha, proving that simple, improved cultural practices developed at CIAT can considerably improve yields over the national average. The most important practices in the trials were: using planting stakes free of cassava bacterial blight and superelongation; good soil preparation; timely weed control; and, ensuring adequate plant populations at harvest (about 10,000 plants/ha).

Work at CIAT has shown that high-yielding hybrids with wide adaptation can be produced and selected relatively easily. The strategy of germplasm improvement through hybridization, is to produce hundreds, or thousands if possible, of combinations which yield more than 50 ton/ha at CIAT, using as many diverse parents as possible. These are then evaluated under great environmental diversity, incorporating as much disease and pest resistance as possible into the whole population.

In 1976, 30,000 hybrid seeds were produced. From plantings in 1975, more than 1,200 lines were harvested from observational yield trials, and another 63 lines harvested from replicated trials. Several of these latter lines yielded more than 40 ton/ha and 30 of the 63 lines were selected for multiplication and further testing. During the year more than 6,600 hybrid seeds were also distributed to other programs for testing.

Mites can significantly reduce cassava yields when they feed on new top growth leaves. This is typical damage from feeding by the *Mononychellus* mite.

A CIAT scientist and his assistant check for mite presence on cassava in the field.

Effects of the frog skin disease of cassava are dramatically shown here; affected plants fail to develop well-filled tubers.

Among the factors sought in improved lines from CIAT are resistance to important insect pests. Preliminary screening tests of materials in the CIAT cassava germplasm bank provided 12 lines that were promising for resistance to the *Tetranychus urticae* mite; 40 lines were selected for intermediate resistance and another 210 selected for further testing against the *Mononychellus tanajoa* mite. While these selections were only small percentages of the total materials screened, they nevertheless may provide sources for resistance for future breeding work.

Simple methods of controlling or eradicating two important cassava diseases were confirmed during the year

In the case of the superelongation disease (caused by the fungus *Sphaceloma manihoticola*), diseased cuttings treated with the fungicide captafol proved to be free of the disease after treatment. The disease is disseminated by infected cuttings and the treatment provides an effective and simple means of control.

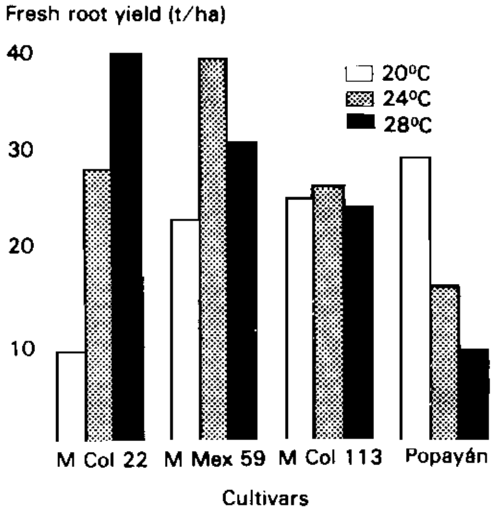
The frog skin disease is also transmitted through infected cuttings from diseased plantations. Little was known about this disease before 1974. This year it was shown that by using healthy cuttings, even if they came from generally infected plantations, the disease can be eradicated in the next planting. The effectiveness of this method is shown in the accompanying table.

Control of the frog skin disease of cassava using healthy planting material

Origin of the Cuttings	Healthy plants	Diseased plants
Cuttings from infected plantations *		
No. of harvested plants	50(13%)**	326(87%)
Yield (kg/plant)	1.40	0.70
Harvest index	0.63	0.33
Cuttings from healthy plantations *		
No. of harvested plants	360(100%)	0.0(0.0%)
Yield (kg/plant)	1.0	
Harvest index	0.84	-

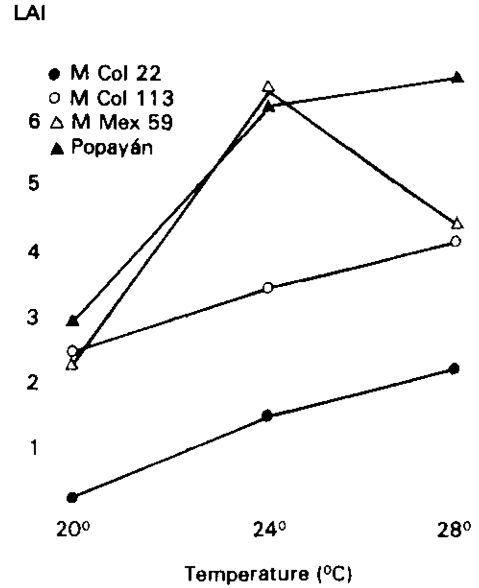
* Cuttings were planted in a field where the previous crop was 92% infected

** Percentage related to the total number of plants harvested



Yield of four cassava cultivars 12 months after planting at three sites having different mean temperatures.

Physiological experiments to assess performance of cassava cultivars over a range of temperatures showed a clear interaction between genotypes and temperature. In addition, the varietal interactions with different temperatures were explained primarily through effects on leaf area formation under the different temperatures.



Leaf Area Indices (LAI) of four cassava varieties eight months after planting at locations with different mean temperatures.

Four cultivars were tested at three sites where mean temperatures were 20°, 24° and 28°C. Several plant growth factors which influence leaf area formation varied in the different temperatures. Yields of the four cultivars are shown in the left figure, and the Leaf Area Indices (LAI) of the cultivars eight months after planting are shown in the right figure. When total yields were compared with the LAI's at the beginning of the critical root formation period it was evident that the previously determined optimum LAI of 3 - 3.5 is valid over a wide range of temperatures and can be utilized as a general, early indicator of yield potential.

In many parts of the world, and particularly on small farms, cassava is grown in association with other crops. Tests were begun at CIAT to study the effects of two crops grown together — in this series of experiments the crops were cassava and field beans. Results from early trials showed that cassava and beans planted together produced as much as 85 percent of the normal monoculture yields of both crops when the two were planted on the same date. The tests will continue to better understand the interactions and the proper planting dates for each crop.

Thirty-two agronomists from nine Latin American countries participated in a one-month intensive course on cassava production. The training was funded by the Canadian International Development Research Centre and was devoted approximately one-third to theory and two-thirds to practical activities. Another 28 trainees worked in the Cassava Program during the year.

In 1976 the CIAT Beef Program began to sharpen its research focus to solve the nutritional problems that limit beef production on vast savanna land areas of Latin America. The common problem on these target land areas is their high acidity and infertility; a secondary problem is often water stress due to severe dry seasons of varying durations and intensities.

The solution being sought for these nutritionally poor savanna grazing lands is creation of year-round, high-quality forage systems. The objectives are first to identify and develop improved, adapted forage species and then develop the optimum management systems for them. These primary activities are complemented by viable animal management and health practices.

As a foundation step to identify useful forages, efforts continued during 1976 to collect and assess materials of several species for inclusion in CIAT's forage germplasm bank. Explorations in several countries of Central and South America yielded promising materials.

Collections in 1976 brought the number of accessions in the germplasm bank to about 1,600 — an increase of more than 30 percent over the number on hand in the previous year. Seed of promising species in the bank was supplied to pasture researchers in 16 tropical countries for various testing purposes

More than one-third of the accessions in the bank are of the genus *Stylosanthes*, a plant adapted in many sections of the tropical savannas. Two important problems, however, dictate that *Stylosanthes* accessions be carefully screened during initial selection procedures

One problem is the disease anthracnose Through work in 1976, about 8 percent of 600 accessions screened proved highly tolerant to the disease

After forage legumes are collected in many regions, they are placed in the long evaluation process in this early screening procedure at CIAT

The stemborer insect is the second important problem; it has seriously affected *Stylosanthes* stands on the Eastern Plains of Colombia, where extensive screening work is done and one of the areas where this forage will

(Above) Stemborers of *Stylosanthes* prefer woody-stemmed ecotypes. Damage like this greatly reduces forage yields and persistence. (Below) Fine-stemmed ecotypes have shown favorable resistance to the stemborer possessing tolerance to anthracnose and the stemborer. Although this species is slow to develop during establishment, it was a prolific producer of seed and showed wide ecotypical variation.

Among other genera of promising forage legumes, species of *Zornia, Desmodium* and *Macroptilium* were found that showed adaptation to infertile, acid soils and which demonstrated some resistance to pests and diseases.

Well along in the evaluation process, this *Stylosanthes* has entered the grazing trial stage at a acid soil location near CIAT.

This *Stylosanthes capitata* plant shows the heavy seed-producing capability of the species. This promising accession was collected in Brazil.

be utilized. These insects (of the genus *Zaratha*) favor species with a hard woody main stem. Evaluations in 1976 identified some *Stylosanthes guyanensis* ecotypes, which because of their fine-stemmed growth characters, have resistance to the stemborer. Some of these same ecotypes are also tolerant to anthracnose.

Stylosanthes capitata accessions from eastern Brazil and Venezuela proved to be well-adapted to very low fertility, highly acid soils, as well as

In work with forage grasses, one promising introduction from northern Nigeria, *Andropogon guyanus*, was selected for intensive testing. It showed major advantages of having excellent tolerance to infertile, acid soils, in spreading naturally and in resisting fire (used as a pasture management practice in many areas of the tropics).

A grass, *Andropogon guyanus*, collected in northern Nigeria, appears promising as a forage. This plot is at Carimagua, on the Eastern Plains of Colombia.

Compatibility between legume forages and *Rhizobium* strains for inoculating them have proven to be an important key in forage development. A CIAT scientist observes a promising strain-*Stylosanthes* reaction here.

A crucial step in producing improved forages is the production of sufficient quantities of seed for wide distribution and testing. Overall production of pasture seed increased during 1976, and plantings of several species were made at two locations not far from CIAT where environments are more favorable for growing materials for seed increase.

Soil microbiology experiments are primarily designed to identify and fully evaluate *Rhizobium* strains that are effective for inoculating legume species. Efficient fixation of nitrogen by legumes is especially important with forages because these materials will eventually be produced on lands so lacking in fertility.

One of the important findings in 1976 was that *Stylosanthes* and strains of *Rhizobium* used to inoculate it were very specific — that is, certain strains were only effective with certain lines of the forage legume.

At least two strains were found which proved much more effective than the

An important step in forage development research is obtaining enough seed of promising lines to permit widespread testing. Here a *Stylosanthes* seed plot is being combined.

strain which had commonly been used to inoculate *Stylosanthes* seed. The strains also differed in their effectiveness under conditions of low soil pH, low phosphorus availability and high aluminum levels — all problems in the areas where improved *Stylosanthes* is to be planted. New strains will be actively collected in the future and evaluations of promising strains will be made for these conditions to build up a collection of highly effective, wide-spectrum inoculants.

Animal health researchers worked to learn more about cattle trypanosomiasis. In Africa, the pathogen *Trypanosoma vivax* is transmitted by the tsetse fly and the disease condition it causes is important to the cattle industry there. Documented knowledge of its mode of transmission and occurrence in Latin America is sketchy although it has been reported in all Latin American countries with an Atlantic coast line from Panama to the mouth of the Amazon River in Brazil, and in two West Indian islands.

CIAT workers had earlier developed a serological test to check for trypanosomiasis. In 1976, this test was refined and used to determine that the disease is probably endemic in all tropical areas of Colombia where cattle are raised in any numbers. Results from Colombia indicated that the disease is more widespread than previously believed. Serum samples from several other countries were also collected and are now being studied.

A two-month short course in epidemiology of animal diseases was organized and supervised in the field by beef team members. The course, for seven trainees, was part of a larger exercise organized and funded by the Panamerican Zoonosis Center.

Thirty-two other persons participated in Beef Program training activities during 1976.

The Swine Nutrition Unit places primary emphasis on the transfer of technology of swine production within Latin America. This is accomplished by training activities within countries and at CIAT, and by various types of assistance to national programs. Research activities within the unit seek to identify and test nutritional systems based on low-cost ingredients that are readily available at the small farm level

At CIAT, the swine team conducted the first Postgraduate Swine Production Course, a six-month training exercise for 20 participants from 10 countries. Activities in the training course consisted of both theory and practice, at CIAT and on several nearby farms in the Cauca Valley of Colombia. The groups also made a one-month trip to visit experiment stations and farms in other ecological zones of Colombia.

Two other professionals were also trained in the Swine Unit during the year.

In international cooperation projects, progress was made in 1976 at several locations. In Bolivia, the Gabriel René-CIAT-Heifer Cooperative Project began its research, training and swine development work at Santa Cruz. First litters from foundation stock were farrowed and some 200 head were distributed to pig farms in the region; other pigs will be used in research at the center. Five one-week training courses were offered to a total of 121 persons in the region as a part of the program.

Training is a very important function of the CIAT swine development work. As technology is already available to significantly increase swine production in Latin America, it is mandatory that information transfer occurs as rapidly and efficiently as possible.

In Peru, facilities for the Swine Unit at the Instituto Veterinario de Investigaciones Tropicales y de Altura (IVITA), in Pucallpa, were completed in 1976 with technical assistance from the CIAT swine team and an IVITA specialist who had previously been trained at CIAT. Foundation stock was also acquired and the unit began its research and swine development work at the regional level.

Three participants in CIAT's Postgraduate Swine Production Course check a piglet while the sow watches carefully.

At the University of Costa Rica, CIAT assisted in planning and conducting the first Central American Seminar on Swine Production, a one-week exercise for approximately 120 persons.

In swine nutrition work, diets based on rice polishings substituted partially for maize as the energy source and with tallow added for additional energy and cane molasses added for increased palatability were compared during the growing and finishing periods. All diets contained soybean meal as the main protein ingredient.

The substitution of rice, polishings, tallow and molasses was nutritionally satisfactory but the price of tallow tended to be excessive for practical use. Results suggested that molasses could be used in increasing amounts if acceptability or palatability of diets based on rice polishings were the only problems.

In another experiment, molasses were added to improve palatability of diets based solely on rice polishings or cassava meal. Addition of molasses proved feasible in both cases. With diets based on cassava meal, considerable amounts of soybean meal were necessary to maintain the desired levels of protein. A price analysis showed that when maize was at least twice as expensive as cassava meal, then the latter ingredient became economical as a source of energy. However, because of its low protein content, cassava meal use also depends closely on the prices of protein ingredients.

Release of two new rice varieties from the cooperative breeding program of CIAT and the Instituto Colombiano Agropecuario (ICA) and the initiation of a Latin American rice testing network under the sponsorship of the International Rice Research Institute (IRRI) and CIAT were the important highlights of rice development activities at CIAT during 1976. Both activities were in strong support of the CIAT Rice Unit's commitment to provide improved plant materials, and the necessary technology to achieve optimum yields from them, to national programs of Latin America.

In 1976 the cooperative rice breeding program of CIAT and the Instituto Colombiano Agropecuario (ICA) released two new varieties of irrigated rice, CICA 7 and CICA 9. In addition, two other promising lines from this breeding program were among materials distributed to several countries for further testing. Line 4422, a sister line to the new CICA 9, was selected and named as Tikal 2 in Guatemala. In Ecuador line 4444 was selected and named as INIAP 7. The table compares the yields of these materials and of other promising lines and commercial cultivars in several countries during tests immediately before the release of the new varieties.

Yields of six promising lines and three commercial varieties of rice in Central America and Colombia, in 1975.

	Country and yield (t/ha)*					
Line or variety	Costa Rica	Honduras	Guatemala	Nicaragua	Panamá	Colombia**
4421***	7 9	6 4	5 4	8 2	5 2	6 9
4422	9 2	5 6	5 6	7 7	5 4	6 8
4440	6 8	6 7	5 9	7 1	4 4	6 9
4444	7 7	4 4	5 4	6 7	4 1	6 8
4461***	8 5	4 8	4 6	5 0	5 6	5 5
4462	7 2	3 9	5 8	5 9	6 1	6 0
CICA 4	5 9	4 3	4 7	6 9	6 5	6 2
CICA 6	4 2	4 0	5 2	6 7	3 3	5 5
CR1113	5 4			5 3	6 0	

* Under upland conditions except in Nicaragua Panama and Colombia which are irrigated

** Average of 34 regional trials in Colombia all other countries are the average of two replications in one trial

*** In 1976 line 4421 was released as CICA 9 variety and line 4461 as CICA 7

Selecting panicles of rice at an early stage of the breeding and evaluation process.

CICA 7 (formerly line 4461) and CICA 9 (line 4421) are tolerant to rice blast and moderately resistant under field conditions to brown leaf spot *(Helminthosporium oryzae)* and stem rot *(Leptosphaeria salvinii)*. They are moderately susceptible to stemborer and to the white rice stemborer and to sheath blight. CICA 7 is moderately susceptible to leaf scald and CICA 9 is tolerant. Both varieties are resistant under field conditions to hoja blanca. The milling and cooking qualities of CICA 9 are similar to those of CICA 6 variety. CICA 7 has excellent milling quality and its cooking quality is similar to CICA 6.

The Unit developed a technique to facilitate producing large amounts of basic seed of the two new varieties as rapidly as possible. The method involved two successive transplantings of young plant materials and a dormancy breaking technique. Beginning with seed from 500 panicles of each line, a total of 137.5 tons of seed was produced in less than a year.

In agronomy studies with irrigated rice, the transplanting of 25- to 40-day-old seedlings into flooded fields provided an excellent method of controlling volunteer and red rice. While some hand weeding was necessary, the larger transplants could be readily distinguished so that weeding could be accomplished easily.

An excellent stand of the new CICA 9 rice variety almost ready for harvesting at CIAT. CICA 9 was developed in the cooperative Instituto Colombiano Agropecuario-CIAT breeding program.

As part of the international cooperation activities of the Rice Unit a network of international rice trials for Latin America was established to accelerate the development, evaluation and dissemination of a continuous flow of improved materials. This work is jointly sponsored by the International Rice

Research Institute (IRRI) and the CIAT Rice Unit

A conference of 35 delegates from 14 countries of the region was convened at CIAT to organize the network. From this meeting, three nurseries were established as a beginning: a yield nursery, a rice blast nursery and an observational nursery. Late in 1976 the yield nursery containing 24 varieties was assembled and distributed to 18 Latin American countries. These activities are part of the International Rice Testing Program organized by IRRI.

The CIAT Rice Unit trained seven professionals during the year.

During 1976 the organization of the Regional Andean Maize Unit was completed and full collaboration between the Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT) and CIAT began with the posting of a CIMMYT scientist to CIAT as coordinator of the project. The unit has the broad objective of transferring maize technology to national programs in the Andean Zone, through direct assistance to the programs and by organizing the interchange and evaluation of plant materials.

An important event in terms of meeting the objectives of the new maize unit was the meeting of the maize producers of the Andean Zone, in October 1977, at Guayaquil, Ecuador. The meeting was organized and sponsored by the Instituto Nacional de Investigaciones Agropecuarias (INIAP). Sixty-four workers from seven countries attended the meeting where plans were made for future cooperative efforts among the countries and with the CIMMYT-CIAT unit.

A total of 23 regional maize trials were distributed in six countries of the target zone during 1976. Fourteen of the trials were designed with materials for tropical areas and nine trials were for highland conditions.

As part of the unit's work at CIAT, three Experimental Variety Trials, using new materials developed at CIMMYT, were grown. These experimental varieties were created on the basis of results from International Progeny Testing Trials. The most promising experimental varieties will be delivered to national maize programs in the Andean Zone for local adaptation studies.

Four of the International Progeny Testing Trials were also grown at CIAT during the year to identify further material for breeding of experimental varieties.

Four professionals from Andean Zone countries were sent to CIMMYT for training.

The CIAT Training and Conferences Unit has a major responsibility for transferring technology from the Center. Through its activities of helping schedule, organize and administer training and seminars, workshops and conferences, the unit plays an important part in helping extend CIAT's technology throughout Latin America and other parts of the world.

A major activity in the area of training at CIAT during 1976 was the transfer of primary training responsibilities from the training office to the various commodity programs. Training has always been an intrinsic part of the functions of the commodity programs and with the evolution of these programs into strong, integrated teams it was believed that each could now carry a greater responsibility in training, both for research ends and for production related to the respective commodities.

Another important reason for this change was the increasing awareness in client national institutions of the advantages of vertically-integrated, single commodity research and production programs to replace the traditional, disciplinary-oriented activities across commodities.

Home countries of trainees studying at CIAT during 1976.

Country	Total trainees	Country	Total trainees
Latin America and the Caribbean		Paraguay	5
		Peru	11
		Puerto Rico	1
Bolivia	6		
Brazil	21	*Other countries*	
Colombia	39		
Costa Rica	1	Canada	1
Chile	5	Fed. Rep. of Germany	3
		Holland	6
Venezuela	8	Indonesia	2
Dominican Republic	8	Japan	2
Ecuador	1		
El Salvador	4	Malaysia	4
Guatemala	6	Spain	1
		Tanzania	1
Guyana	1	Thailand	6
Honduras	8	United Kingdom	4
Mexico	18	United States	7
Nicaragua	3		
Panama	5	Total	188

The training office continued to administer the trainees coming to CIAT and to assist the commodity programs in developing training plans and providing training assistance.

The table on this page shows the countries from which professionals came for training in 1976.

As a part of its assistance to the overall training functions of the Center, the training office began, in 1976, an intensive program to design and produce audio-tutorial training materials. These materials are designed to permit individualized instruction to the trainee complementary with group discussions, direct trainee/scientist interaction and laboratory/field experiences.

The CIAT conference office coordinated 14 events during 1976 in which the Center was the primary sponsor or a co-sponsor. The office also provided organizational support for another eight events sponsored by outside institutions

As a unit charged with assisting international cooperation and technology transfer functions of CIAT, the Library and Information Services Unit is concerned with the collection, production and dissemination of written materials. These materials consist of scientific bulletins, scientific information abstracts, popular materials and other information services for providing published materials to client and other requesting countries.

Principal activities realized in 1976 by the Library and Information Services Unit at CIAT were in the area of documentation of scientific information.

The Documentation Center of the Library processed and distributed more than 3,200 abstracts of publications and articles in the three fields of beans, cassava, and agricultural economics and development in Latin America. Additionally, the Documentation Center helped produce three volumes of collected abstracts (one volume in each of the three fields).

An agreement was completed with the Instituto Interamericano de Ciencias Agrícolas (IICA) to facilitate the distribution of the Library's Tables of Contents service and payment for photocopies of materials requested from CIAT's Library. This agreement enables countries having stringent foreign exchange requirements to obtain photocopied materials more easily by routing their request through IICA representatives in various countries.

A new bibliographic service, called Selected Book Reviews, was initiated. As well as being a current awareness tool for scientists, the service will also help librarians in their acquisitions activities.

The CIAT Special Studies Unit undertakes limited research activities on problem not being worked on by other programs or units of the Center. Several of the unit projects are directed to exploring technology that could be of use on small, tradition farms.

During the year, several experiments were conducted to study the management of crop associations involving maize and perennial legumes. The perennial peanut, *Arachis glabrata*, reduced maize lodging by as much as 50 percent, and by cutting the mulch onc (two cuttings are possible during or maize crop), as much as 57, 8 and 4 kilograms of nitrogen, phosphorus an potassium, respectively, were recycle per hectare. A second legum *Leucaena leucocephala*, is a bush tree legume plant

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Left during 1976

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Beef Production Training

Training

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** Assigned to more than one program

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