

GERMPLASM EXCHANGE WITHIN THE BEAN NETWORK

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To facilitate the understanding of the way in which the Bean germplasm flow managed by CIAT is organized, we will briefly review the structure of the Bean Program at the Center.

Organization of CIAT's Bean Program

The Program operates worldwide by means of a decentralized organization that outposts scientific personnel in different regions of the world. The following is the distribution of the different operational units of the Bean Program:

- Central headquarters located in Palmira, Colombia with its own responsibilities and acting as support for different regional activities.
- Six regional programs covering the main bean producing regions of the world:
 - Bean Project for Central America and the Caribbean serving all those nations located in the Central American isthmus and the Caribbean Basin. This project also encompasses the Gulf and the Pacific Coast of Mexico.
 - Bean Project for the Andean Zone including Venezuela, Ecuador, Peru and Bolivia.
 - Bilateral Agreement with Brazil.
 - Regional Bean Program for Southern Africa, serving the republics of Tanzania, Malawi, Zimbabwe, Mozambique, Zambia, Angola, Botswana, Lesotho and Swaziland.
 - Regional Bean Program for the Great Lakes, operating in Burundi, Rwanda and Zaire.
 - Regional Bean Program for Eastern Africa serving Uganda, Kenya, Somalia and Ethiopia.

Inter-relationships between the headquarters, the regional and the national programs.

Each regional program operates within strict geographical boundaries for the respective region. The National Programs located within the region have direct contact amongst them or through the CIAT's regional coordinator who acts as contact with CIAT's headquarters.

The Program in Palmira headquarters operates worldwide. With the exception of the plant breeders, each member of the Program has direct relationships with the National Programs. The sphere of action of each of the three breeders is limited to certain countries or regions with the purpose of having each focusing on given grain types of plant types preferred by consumers and by producers in well established areas. Thus, each plant breeder is responsible for developing breeder's material for the following regions:

- Breeder I: Central America, the Caribbean, coastal areas of Mexico, and areas in Brazil where there is preference for black (preto) and red (roxo, roxinho, roxao) beans.
- Breeder II: Northwest Argentina, Chile, Brazil (with the exception of those areas specifically covered by Breeder I) Highlands of Mexico and the Middle East.
- Breeder III: Andean Zone and Africa. Likewise this Breeder is responsible for the green beans work worldwide.

As you can see, each breeder maintains relationships with a given country whether directly or through the regional program, but none can go beyond their territorial sphere of influence. This provision is to avoid overloading the National Programs with a supply of materials developed for other regions. As a consequence of this arrangement, Breeder I works with small seeded black and red beans which are consumed the most in Central America, the Caribbean, eastern coast of Mexico and large areas of Brazil. Breeder II, concerns himself with the white seeded beans planted in Argentina. Chile and the Middle East, the carioca, and mulatinhos from Brazil, and the yellow, ojo de cabra, pinto and flor de mayo from Mexico. Breeder III, concentrates on large seeded light color varieties that are preferred in the Andean zone in the south, or the red mottled beans preferred in the northern Andean Zone and in Africa.

The provision of assigning to each breeder a well established geographical area guarantees the concentration of their efforts on given grain types and varieties. It is also their responsibility to develop genetic material that can be used in breeding projects for specific purposes, this in order to contemplate in breeding work, the most important limiting factors to production. A partial list of work areas or projects which are responsibility of each breeder follows:

- Breeder I: Rust, Common Bacterial Blight, Empoasca, Apion, Nitrogen Fixation, Golden Mosaic.
- Breeder II: Anthracnose, Angular Leaf Spot, Drought, Low P levels, High yield potential.
- Breeder III: Ascochyta, Halo blight, Bean fly, Nematodes.

GERMPLASM FLOW BETWEEN MAIN HEADQUARTERS, REGIONAL PROJECTS AND NATIONAL PROGRAMS

Germplasm flow from headquarters to the different regional and national programs is done per section (individual) and per program (team).

1. Germplasm flow at personal level

This germplasm flow at section (personal) level is carried out by each breeder at CIAT with their peers in each one of the countries within the geographic area of their responsibility. Within this same category are those germplasms distributed as specialized nurseries for specific purposes, by the other scientists in the program (pathologist, entomologist, microbiologist, physiologist).

The distribution of material in this modality is restricted to the collaborators of the scientist in charge of a given discipline. Each one of the three breeding programs maintains its respective nurseries for distribution to the breeders within his area of responsibility. The following is the account of nurseries for each specialist in the Bean Program:

Breeding I:

- Adaptation nursery

Breeding II:

- Crossing blocks
- Segregating materials
- Adaptation nursery

Breeding III:

- Crossing blocks
- Bulks
- Adaptation nursery

Pathology:

- Bean Angular Leaf Spot International Trial (BALSIT)
- International Bean Anthracnose Trial (IBAT)
- International Bean Rust Nursery
- International Bean Nursery for Common Bacterial Blight (VIB)
- International Bean Wilting by Fusarium oxysporum nursery (VIMFO)
- International Bean Root Rot Nursery by Rhizoctonia solani (VIPRS)

- Bean Root Rot International Nursery (BRRIN)
- International Bean White Mould Nursery
- International Bean Apion Nursery
- International Bean Empoasca Nursery

Microbiology:

- International Bean Inoculation Trial (IBIT)

Physiology:

- Bean International Drought Adaptation Nursery (BIDAN)
- Bean International Drought Yield Trial (BIDYT)
- Bean International High Temperature Adaptation Nursery (BIHAN)

2. Team germplasm flow

Germplasm distributed on a personal base as in 1. above, has two main characteristics:

- a) It is restricted to a limited number of collaborators and to specific regions, and
- b) The germplasm distributed does not have to have a commercial value since it is geared for use as working material

Germplasm distributed at team level is to place at the availability of all regions and programs the germplasm developed by each breeder of CIAT. Different from the prior scheme, the germplasm flow at this level is characterized by the fact that:

- a) Germplasm at this level is distributed and available to any institution engaged in bean research and work.
- b) Only advanced lines having at least one outstanding trait, and having commercial grains are distributed.
- c) The origin of the material is manifold, and they may originate from CIAT's bean program, or from the germplasm bank or from any other institutions that develops bean genetic material.

In order to guarantee that the germplasm distributed fulfils certain requirements to make it appealing for the national programs, CIAT's Bean Program developed in 1978 a three-stage evaluation system that has evolved throughout time to reach the modus operandi described below:

Brief description of the Germplasm evaluation and distribution scheme for the Bean Team of CIAT.

The scheme of organization, distribution of materials, data collection and analysis and dissemination of results is responsibility of the Agronomy-International Trials Section.

The evaluation system is made up of three successive nurseries each of which constitutes the basis for screening those materials which will enter the following nursery. Each nursery has a duration of one year.

All of the materials entering the nurseries are available to all institutions working on beans; the purpose of the evaluations is to priorly screen the materials on the basis of their main traits in order to rationalize the distribution in accordance to the user's interests.

The three nurseries of the evaluation scheme are known with the spanish acronym VEF which means Nursery of the Bean Team, EP, standing for Preliminary Yield Trials and IBYAN, for International Bean Yield and Adaptation Nursery. The materials of the first two nurseries, VEF and EP, are distributed as observation nurseries (small samples without replications), not necessarily uniform, but adapted upon specific request from the interested party; the last nursery, IBYAN, is distributed as a yield trial with three replications and is uniform for each type of commercial grain category.

In overall terms the scheme operates as follows:

- Every year the three breeders from CIAT release their best materials to Agronomy. This release has certain restrictions:
 - It is done on fixed date (February each year)
 - Each breeder can release up to 500 lines
 - Materials must be resistant to common bean mosaic
 - The lines must be advanced ones (no segregating) and the grain characteristics to meet commercial standards.

The 1500 lines fulfilling these conditions after being classified within the respective commercial category, are subjected to study for one year in Palmira, Popayan and Quilichao in the VEF nursery, at which time evaluations are made with regard to disease resistance considering 6 entities (rust, anthracnose, angular leaf spot, ascochyta, common bacterial blight and common mosaic) and to the most common insect in

bean producing areas (Empoasca kraemeri). None of the materials from the VEF nursery is discarded. The Program maintains it for two years after completion of evaluation and the lines remain available should anyone request them. However, not any line with susceptible reactions to any of the six diseases mentioned is selected for study in the next stage within the scheme.

The Preliminary Yield Trial EP, is formed by those materials selected in VEF, i.e., no susceptible material goes to EP. This trial is tested in three sites, Palmira, Popayan and Santander de Quilichao and in it, besides the above mentioned diseases and the reaction to damage from Empoasca, evaluation is made of lines' yield in homogeneous trials within a given commercial grain type. Lines in EP trials are evaluated also for other characteristics by the Team. The materials tested in the EP nurseries are distributed internationally not as Yield Trials but as Observation Nurseries in order to make elite materials available to research workers, as result of evaluations made at headquarters. EP materials are stored permanently at the germplasm bank.

The most outstanding materials from EP and VEF nurseries form the raw materials to select treatments for the international bean yield trials.

The International Bean Yield and Adaptation Nursery (IBYAN) constitutes the third stage of the evaluation scheme. These bean yield trials are formed by lines of a same commercial category. These are uniform trials distributed worldwide.

Improved Germplasm contribution to the Bean network from other Research Programs in the World.

Although many lines coming from other bean research programs different to CIAT's Bean Program, have been distributed through the network, it cannot be stated that there is a system by which it may be guaranteed that the very best materials being produced in the world go through evaluation in the network system. It is an undeniable fact that exchanges exist independent from the network, and we believe it is desirable to establish a procedure in order to systematize improved germplasm flow from other programs to CIAT's network. This in no way is to curtail the right to free bilateral exchanges independent from the network (our own researchers maintain exchanges at personal level), neither is it to institute a commitment to deliver materials which a researcher does not wish to share (our own researchers are free to turn in to VEF only those materials they so wish).

The advantages of systematizing the germplasm flow would be as follows:

- Every year bean research workers would have the best commercial type materials available from the stock of worldwide breeders.
- As consequence of inclusion in VEF trials those materials would have been tested for at least six main diseases.

- Due to the fact that prior to evaluation in VEF the materials are submitted to Quarantine Regulations in Colombia, the seed to be distributed would be of guaranteed health.

SUMMARY OF TRIALS SENT AND DATA RECEIVED
PER YEAR BASIS

IBYAN 1976-1986

| Year | No. of trials sent | % of Total | Data Recovered | % of Year |
|------|-----------------------|---------------|-------------------|--------------|
| 1976 | 92 | 3.8 | 55 | 59.8 |
| 1977 | 108 | 4.5 | 61 | 56.5 |
| 1978 | 167 | 7.0 | 109 | 65.3 |
| 1979 | 175 | 7.3 | 104 | 59.4 |
| 1980 | 337 | 14.1 | 155 | 46.0 |
| 1981 | 275 | 11.5 | 126 | 45.8 |
| 1982 | 293 | 12.3 | 130 | 44.4 |
| 1983 | 308 | 12.9 | 130 | 42.2 |
| 1984 | 238 | 10.0 | 112 | 47.0 |
| 1985 | 251 | 10.5 | 122 | 48.6 |
| 1986 | 145 | 6.1 | 23 | 15.9 |

SUMMARY OF TRIALS SENT AND DATA REPORTED

IBYAN 1976-1986

| | <u>Country</u> | | <u>Trials</u> | |
|--------------------|----------------|-------|---------------|-------|
| | No. | % | No. | % |
| Report of Data | 63 | 62.4 | 1127 | 47.2 |
| No. Report of Data | 38 | 37.6 | 1262 | 52.8 |
| | 101 | 100.0 | 2389 | 100.0 |

SUMMARY OF TRIALS SENT AND DATA REPORTED

IBYAN 1976-1986

| | Number | % |
|----------------|--------|-------|
| TRIALS SENT | 2.389 | |
| DATA RECOVERED | 1.127 | 47.17 |

SUMMARY OF TRIALS SENT AND DATA REPORTED

PER REGION BASIS

IBYAN 1976-1986

| Region | No. of trials sent | % of Total | Data Recovered | % of Region |
|--------------------|--------------------|------------|----------------|-------------|
| SOUTH AMERICA | 976 | 40.8 | 576 | 59.0 |
| CENTRAL AMERICA | 488 | 20.4 | 206 | 42.2 |
| CARIBBEAN BASIN | 195 | 8.2 | 71 | 36.4 |
| NORTH AMERICA | 132 | 5.5 | 67 | 50.8 |
| EAST AFRICA | 232 | 9.7 | 95 | 40.9 |
| WEST AFRICA | 65 | 2.7 | 12 | 18.5 |
| NORTHERN AFRICA | 8 | 0.3 | - | - |
| SOUTHERN AFRICA | 135 | 5.6 | 57 | 42.2 |
| WEST ASIA | 46 | 1.9 | 18 | 39.1 |
| EAST ASIA | 62 | 2.6 | 11 | 17.7 |
| EUROPE | 44 | 1.8 | 10 | 22.7 |
| AUSTRALIA OCCEANIA | 5 | 0.2 | 4 | 80.0 |

SUMMARY OF TRIALS SENT PER COUNTRY BASIS. IBYAN 1976-1986

| Country | Trials sent | % of Total | Country | Trials sent | % of Total | Country | Trials sent | % of Total |
|----------------|-------------|------------|--------------|-------------|------------|---------------|-------------|------------|
| ANGOLA | 27 | 1.1 | GUINEA BISS | 7 | 0.3 | PUERTO RICO | 7 | 0.3 |
| ARGENTINA | 131 | 5.5 | GUYANA | 3 | 0.1 | R. D. ALEMANA | 2 | 0.1 |
| AUSTRALIA | 2 | 0.1 | HAITI | 40 | 1.7 | R. DOMINICANA | 37 | 1.5 |
| BANGLADESH | 3 | 0.1 | HONDURAS | 103 | 4.3 | RWANDA | 50 | 2.1 |
| BARBADOS | 5 | 0.2 | HUNGRIA | 3 | 0.1 | RUSIA | 1 | - |
| BELIZE | 18 | 0.8 | INDIA | 3 | 0.1 | SAO TOME | 3 | 0.1 |
| BOLIVIA | 70 | 2.9 | INDONESIA | 6 | 0.3 | SIERRA LEONA | 6 | 0.3 |
| BRASIL | 155 | 6.5 | INGLATERRA | 3 | 0.1 | SRI LANKA | 4 | 0.2 |
| BULGARIA | 7 | 0.3 | IRAN | 2 | 0.1 | ST. HELENA | 2 | 0.1 |
| BURUNDI | 29 | 1.2 | ISRAEL | 3 | 0.1 | ST. KITTS | 2 | 0.1 |
| CAMERUN | 7 | 0.3 | ITALIA | 15 | 0.6 | ST. LUCIA | 2 | 0.1 |
| CANADA | 6 | 0.3 | JAMAICA | 22 | 0.9 | SUDAN | 2 | 0.1 |
| CHECOSLOVAQUIA | 1 | - | JAPON | 2 | 0.1 | SUR AFRICA | 50 | 2.1 |
| CHILE | 83 | 3.5 | KENYA | 6 | 0.3 | SURINAM | 4 | 0.2 |
| CHINA | 9 | 0.4 | LESOTHO | 5 | 0.2 | SWAZILAND | 31 | 1.3 |
| COLOMBIA | 309 | 12.9 | LIBANO | 2 | 0.1 | SYRIA | 3 | 0.1 |
| COMOROS | 2 | 0.1 | LIBERIA | 1 | - | TAIWAN | 2 | 0.1 |
| COREA | 1 | - | LIBIA | 2 | 0.1 | TANZANIA | 33 | 1.4 |
| COSTA RICA | 127 | 5.3 | MALAWI | 14 | 0.6 | THAILANDIA | 9 | 0.4 |
| CUBA | 61 | 2.6 | MARTINICA | 1 | - | TOGO | 4 | 0.2 |
| CYPRUS | 3 | 0.1 | MAURITIUS | 13 | 0.5 | TRINIDAD | 12 | 0.5 |
| DOMINICA | 3 | 0.1 | MEXICO | 90 | 3.8 | TUNEZ | 3 | 0.1 |
| ECUADOR | 36 | 1.5 | MOZAMBIQUE | 5 | 0.2 | TURQUIA | 7 | 0.3 |
| EGIPTO | 1 | - | NEPAL | 4 | 0.2 | USA | 36 | 1.5 |
| EL SALVADOR | 75 | 3.1 | NETHERLANDS | 2 | 0.1 | UGANDA | 11 | 0.5 |
| ESPAÑA | 1 | - | NICARAGUA | 86 | 3.6 | URUGUAY | 7 | 0.3 |
| ETHIOPIA | 13 | 0.5 | NIGER | 1 | - | VENEZUELA | 53 | 2.2 |
| PHILIPINAS | 32 | 1.3 | NUEVA GUINEA | 3 | 0.1 | YEMEN ARABE | 5 | 0.2 |
| FRANCIA | 1 | - | OMAN | 1 | - | YUGOSLAVIA | 1 | - |
| GABON | 4 | 0.2 | PAKISTAN | 6 | 0.3 | ZAIRE | 14 | 0.6 |
| GHANA | 6 | 0.3 | PANAMA | 21 | 0.9 | ZAMBIA | 56 | 2.3 |
| GRECIA | 3 | 0.1 | PARAGUAY | 25 | 1.0 | ZANZIBAR | 1 | - |
| GUATEMALA | 58 | 2.4 | PERU | 103 | 4.3 | ZIMBABWE | 32 | 1.3 |
| GUINE | 1 | - | PORTUGAL | 4 | 0.2 | | | |

No. of countries : 101
No. of trials : 2389

SUMMARY OF TRIALS SENT AND DATA RECEIVED PER COUNTRY BASIS
IBYAN 1976-1986

| Country | Data Recovered | % of Country | Country | Data Recovered | % of Country |
|-------------|----------------|--------------|---------------|----------------|--------------|
| ANGOLA | 4 | 14.8 | MALAWI | 2 | 14.3 |
| ARGENTINA | 60 | 45.8 | MAURITIUS | 5 | 38.5 |
| AUSTRALIA | 2 | 100.0 | MEXICO | 47 | 52.2 |
| BELIZE | 10 | 55.5 | MOZAMBIQUE | 1 | 20.0 |
| BOLIVIA | 22 | 31.4 | NICARAGUA | 24 | 27.9 |
| BRASIL | 73 | 47.0 | NUEVA GUINEA | 2 | 66.6 |
| BULGARIA | 6 | 85.7 | PANAMA | 7 | 33.3 |
| BURUNDI | 11 | 37.9 | PARAGUAY | 10 | 40.0 |
| CAMERUN | 2 | 28.6 | PERU | 55 | 53.4 |
| CANADA | 3 | 50.0 | PUERTO RICO | 2 | 28.6 |
| CHILE | 70 | 84.3 | R. DOMINICANA | 17 | 45.9 |
| COLOMBIA | 239 | 77.3 | RWANDA | 20 | 40.0 |
| COSTA RICA | 53 | 41.7 | SAO TOME | 2 | 66.6 |
| CUBA | 30 | 49.2 | ST. HELENA | 2 | 100.0 |
| CYPRUS | 2 | 66.6 | ST. LUCIA | 1 | 50.0 |
| ECUADOR | 13 | 36.1 | SUR AFRICA | 31 | 62.0 |
| EL SALVADOR | 48 | 64.0 | SWAZILAND | 10 | 32.2 |
| ETHIOPIA | 5 | 38.5 | SYRIA | 3 | 100.0 |
| FILIPINAS | 2 | 6.2 | TAIWAN | 2 | 100.0 |
| GABON | 1 | 25.0 | TANZANIA | 14 | 42.4 |
| GRECIA | 2 | 66.6 | THAILANDIA | 5 | 55.5 |
| GUATEMALA | 18 | 31.0 | TOGO | 3 | 75.0 |
| HAITI | 16 | 40.0 | TURQUIA | 4 | 57.1 |
| HONDURAS | 46 | 44.6 | USA | 17 | 47.2 |
| INDIA | 1 | 33.3 | UGANDA | 4 | 36.4 |
| INDONESIA | 1 | 16.6 | URUGUAY | 3 | 42.9 |
| INGLATERRA | 2 | 66.6 | VENEZUELA | 31 | 58.5 |
| IRAN | 1 | 50.0 | YEMEN ARABE | 2 | 40.0 |
| ISRAEL | 3 | 100.0 | ZAIRE | 9 | 64.3 |
| JAMAICA | 5 | 22.7 | ZAMBIA | 29 | 51.8 |
| JAPON | 1 | 50.0 | ZIMBABWE | 9 | 28.1 |
| LIBANO | 2 | 100.0 | | | |

No. of countries : 63
No. of trials : 1127

SUMMARY OF TRIALS SENT WITHOUT ANY DATA REPORTED
PER COUNTRY BASIS

IBYAN 1976-1986

| Country | No. of trials sent | Country | No. of trials sent |
|------------------|-----------------------|--------------|-----------------------|
| BANGLADESH | 3 | LIBERIA | 1 |
| BARBADOS | 5 | LIBIA | 2 |
| CHECOSLOVAQUIA | 1 | MARTINICA | 1 |
| CHINA | 9 | NEPAL | 4 |
| COREA | 1 | NIGER | 1 |
| COMOROS | 2 | OMAN | 1 |
| DOMINICA | 3 | PAKISTAN | 6 |
| EGIPTO | 1 | PORTUGAL | 4 |
| ESPAÑA | 1 | R.D. ALEMANA | 2 |
| FRANCIA | 1 | RUSIA | 1 |
| GHANA | 6 | SIERRA LEONA | 6 |
| GUINEA | 1 | SRI LANKA | 4 |
| GUINEA BISSAU | 7 | ST. KITTS | 2 |
| GUYANA | 3 | SUDAN | 2 |
| NETHERLANDS | 2 | SURINAM | 4 |
| HUNGRIA | 3 | TRINIDAD | 12 |
| ITALIA | 15 | TUNEZ | 3 |
| KENYA | 6 | YUGOSLAVIA | 1 |
| LESOTHO | 5 | ZANZIBAR | 1 |
| No. of countries | | : | 38 |
| No. of trials | | : | 1262 |

SUMMARY OF OBSERVATIONAL TRIALS
VEF/EP 1985-1987

| COUNTRY | No. of Sets VEF/EP | COUNTRY | No. of Sets VEF/EP |
|-------------------|-----------------------|---------------------|-----------------------|
| ARGENTINA | 2 | MEXICO | 10 |
| BOLIVIA | 7 | NICARAGUA | 17 |
| BRASIL | 3 | PANAMA | 11 |
| BULGARIA | 2 | PERU | 3 |
| CHINA | 1 | PUERTO RICO | 8 |
| COLOMBIA | 3 | REPUB. SOUTH AFRICA | 32 |
| COSTA RICA | 27 | RWANDA | 12 |
| CUBA | 3 | TANZANIA | 1 |
| ECUADOR | 1 | UGANDA | 8 |
| EL SALVADOR | 11 | URUGUAY | 8 |
| ESPAÑA | 10 | USA | 14 |
| GUATEMALA | 27 | VENEZUELA | 8 |
| HONDURAS | 14 | ZAIRE | 9 |
| ITALIA | 3 | ZAMBIA | 30 |
| KENYA | 2 | | |
| No. of countries: | | 29 | |
| No. of sets: | | 287 | |