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COCOA RESEARCH AND TECHNOLOGY TRANSFER TEAM

PROJECT: COCOA PRODUCTIVY AND QUALITY IMPROVEMENT, A PARTICIPATIVE APROACH

Comparación de distintos clones de cacaos provenientes de árboles seleccionados a partir de progenies híbridas en el marco del proyecto CFC/ICCO/BIOVERSITY INTERNATIONAL (Planting date: Marzo 2008)

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ABSTRACT (Minimum 100 words)	The CFC/ICCO/Bioversity International Project, Chapter INIAP-Ecuador, provided an opportunity to continue evaluating most of the hybrid and clone trials started during the CFC/ICCO/IPGRI project (1998-2003), as well as starting participative cocoa research with the inclusion of producers pursuing a more efficient selection of superior cacao cultivars. Under the umbrella of the current project an agro-socio-economic study was completed providing some useful insights on the multifactor environment which mediates cacao production in three distinct zones. Some important germplasm collection activities took place under the umbrella of this project enriching the phenotypic and genotypic variability of the cacao genetic bank held by INIAP at the Estación Experimental Tropical Pichlingue. The project's period was also fruitful at providing information on the influence of some agronomic factors (sexual compatibility, pruning levels, planting density, drought resistance, differences in flowering and other phenological markers) as well as on sensorial differences among distinct genotypes. Best hybrid trees were selected and multiplied as clones to compare their performance in trials which are currently being conducted both at the E. Pichilingue and farmer's fields. Hopefully, these experiments will be the source of new commercial fine or flavor cacao cultivars in the near future. The most important output of both, the CFC/ICCO/IPGRI and CFC/ICCO/Bioversity International projects, are represented by its contribution, together with those of other projects, toward building up an important genetic base to gradually develop new cacao varieties well into the next quarter of the century. Training and opportunities to develop research, agronomic and managerial experience for a number of people locally involved in the project represent an additional dimension in which the project made valuable contributions. We may well divide the cacao breeding process in Ecuador into two parts; before and after the period 2008-2009, when the CFC/ICCO/IPGRI and CFC/ICCO/Bioversity projects took place.
KEYWORDS	Country/Region: Ecuador /America Latina Crop(s): Cacao Subject: Productivity, Quality, Improvement, Participatory selection

INTRODUCCION

Cocoa Production Constraints

To take adventage of its position in the world as the main fine or flavor cacao producer and exporter, Ecuador needs to overcome obstacles that keep cacao production from growing faster. Challenges are varied but productivity and quality development are among the ones placing the largest influence. Low cacao productivity is preceded by several causes: poor performance of traditional cacao fields, low yielding planting material, high vulnerability to diseases (witche´s broom and moniliasis). Productivity become even more depresed in areas marginal to grow cacao due to adverse environmental (particularly drough and soil fertiliy constraints) conditions.

Around 80% of the land planted to cacao is on hands of smallholders. They think twice before making sure they want to go ahead with an investment decision to increase the productivity of traditional cacao fields. Qualified plants are at the heart of any production system. If their genetic base is poor for high yield and disease resistant potential, the risk of not getting the return to any investment is high. This scenario weakens the will of the producer to keep on going this idea of investing in cacao. It is clear then that the supply of genetically improved cacao cultivars equipped with a high yielding potential and less vulnerabilty to diseases is key to contribute to a solution to the problem of the low average cacao yield, under 0.3 tons per hectare, and the slow growth of fine or flavor cacao production and exports.

Cocoa Breeding Objectives

A host of factors associated to the problem of the low average cacao yield in Ecuador stands in the background of the urgency to develop new fine or flavor cacao varieties. As stated earlier, witches´ broom and moniliasis incidence combined with a low yielding potential of the planting material present in the tradidional cacao fields, are by far the main factors limiting productivity and production of fine or flavor cacao. Both diseases represent a depressing factor since the early 20´s when they appeared and turned quickly into a epidemic problem. We should mention this was the main antecedent to begin formal research activities in this crop, as part of a Cooperation Agreement in 1943 between the Goverments of USA and Ecuador.

During the period 1920-1935 diseases cut the cacao production down to 25% (from 40,000 tons to around 10,000 tons) from its original level, creating an unprecedented national economic crisis since it represented at that time more than 60% of the income by exports. In response to this grave situation isolated and individual efforts by some producers took place during the 30´s to select in their cacao fields those trees showing limited disease incidence. These were further reproduced by seeds to replace the plants destroyed by the diseases. Genetic segregation diluted any benefit that could have been expected from these initiatives to face this sanitary problem. Clonal technology to fix favorable traits of the selected trees was unknown at that time.

These first actions opened the road to visualize and formulate the objectives of cacao genetic improvement after the institutionalization of a cacao research program based at the Hacienda Pichilingue which became later the Estacion Experimental Tropical Pichilingue of INIAP. These objectives have been adjusted through time and are summarized as follows.

1) To set up a germplasm bank with sufficient genetic variability to increase the opportunities to select breeding material or genotypes worth of deserving further development as clonal cultivars; 2) To increase the allelic frequency of genes associated to high yield and disease resistance traits in breeding populations; 3) To used this breeding populations to select hybrid and clones which combine high yield potential and disease resistance; 4) To incorporate the criteria of integral quality for additional screening of these selections; 5) To develop and release to farmers superior cacao varieties equiped with a combination of attributes, mainly disease resistance, high yield and integral quality, placing emphasis on fine or flavor cacaos.

The activities executed in the frame of both, the CFC/ICCO/IPGRI and CFC/ICCO/Bioversity International projects, Chapter INIAP-Ecuador, contributed through different ways to the progress made toward the attainment of the stated objetives.The genetic base of the local genebank was widened and enriched through the introduction of foreign and local cacao germplasm. The planning and excecution of several crossing schemes led to the attainment of hybrid populations with a possible increase of the frequency of alleles associated to disease resistance, high yield and better quality standards. A close examination has unveiled opportunities to select superior hybrid trees which have been multiplied as clones to compare their performance in formal trials.

On the other hand, studies conducted on the physical and sensorial properties of many of the trees making up the hybrid populations generated useful data to visualize a wide range of opportunities to improve the process of selection of genotypes of interest. Clonal planting material of at least six of these selections has been planted as large plots (100 plants per plot and two replications) to observe their performance before making a final selection of those showing economic potential to be released as fine or flavor varieties (within the next 5-6 years).

The CFC/ICCO/IPGRI and CFC/ICCO/Bioversity International were not isolated projects. On the contrary, they complemented nicely allowing the continuity of research activities started before 1998, implementing new breeding activities during the period 1998-2003 and enlarging the scope of these activities (2004-2009) to embrace the inclusion of farmers in the process of evaluation and selection of new cacao cultivars, all this as part of a participative research focus.

CURRENT STATUS OF COCOA VARIETIES

Unselected varieties

The age of most of the traditionally cacao fields in Ecuador usually range between 30 and 100 years. They have been established using seeds of pods harvested in trees selected by the producer. These selections have been made on the basis of traits of economic importance such as a large number of healthy pods, preferable of large size, and resistance to diseases. In the past most farmers held the belief that these attributes would reproduced faithfully in their descendants. The phenomenon of genetic segregation preventing the replication in the descendants of the desirable attributes was largely unknown by them. At the end only a few trees became productive.

Local observations have demonstrated that aproximately 30% of the trees make up for 60 to 70% of the total production in a traditional cacao field, while the 30% of the less productive trees make up hardly for 6 to 8% of the total production. There are a few trees which are able to produce 100 or more healthy pods per year, though in many cases these are small, an undesirable trait that increases the time farmers devote to harvest. Some of the trees do not produce any pod altogether as has been observed.

During the 60´s and the 70´s INIAP distributed hybrid seeds from a group of crosses among Nacional x Trinitario types selections and Upper amazonian genotypes (Scavina 6, Scavina 12, Silecia 1, IMC 67, among others) showing resistence to witches´broom. These planting material bacame part of the traditional cacao fields, mainly in the central and northern cacao growing zones of the coastal region.

A gradual increase in the production and hence exports from the 50´s up to the present is better explained by a rise in the surface planted to cacao rather than to higher yields per hectare. The accelerated planting of the clon CCN 51 is responsible for most of the new cacao fields during the last decade, as well as an important jump in the total production. However, an study by Amores (1999) concluded that a modest increase in productivity did take place in the second half of the XX century as a result of tecnology transfer activities and release of hybrid seeds and clones by INIAP.

Recommended varieties

In the late 70´s a group of superior cacao clones were released by INIAP for commercial planting. These were the output of a process that started in the late 40´s and early 50´s. After visiting hundreds of farms in distinct cacao growing zones a number of trees were selected based on visual observations. The high yielders with some disease´s resistance were identified and selected for further cloning. The clones were used to set up observation plots in the E.Pichilingue. Several years of careful evaluation led to the selection of the clones EET 103, EET 96, EET 95, EET 64, EET 48 and EET 19 to be released as a clonal variety of the Nacional type.

Observations completed on the frame of the CFC/ICCO/Bioversity International project demonstrated that the combined planting of the clones EET 103, EET 96 and EET 95 yield 15 % higher as compared to planting of a mixture of all recommended clones. Based on this conclusion more emphasis is placed on the multiplication and supply to farmers of the first three clones.

Additional observations in the frame of the project have allowed to reinforced the idea that the clone EET 103 has a wide range of adaptation to several growing environments, ranking it as a sort of a universal clone. Finally, the experiences and formal information provided by both, the CFC/ICCO/IPGRI and CFC/ICCO/Bioversity International projects, and others conducted simultaneously, turned into valuable inputs for the attempts made in relation with zonification for the planting of new cacao fields, using the varieties recommended by INIAP.

Unfortunally, simultaneous comparison of these Nacional type clones to CCN 51, a high yielding clone lacking the alleles which are typical of the Nacional variety as has been clearly demontrated through several genetic analysis, showed that they yield quite less that CCN 51 under no irrigation conditions. However, in spite of having nice physical qualities (large size, homogeneity, etc.) the market does not grade CCN 51 as a fine or flavor variety.

In the worst case CCN 51 yield twice as EET 103. However, under irrigation this difference is shortened to only 20% in a couple of zones where comparative studies were completed. Even more, EET 103 and CCN 51 difference in yield was not statistically different in a trial conducted in a piedmont area with good rainfall distribution; the altitude of the experimental site is 500 m above sea level and possibly it has to do with this result. A cacao Field day is being planned to take place in the next few months to show the EET 103 performance at this site reinforcing it as an option to grow cacao in this particular area.

In early 2009 a new group of cacao clones was released for commercial planting, adding these up to the stock of Nacional type clones INIAP is currently recommending. These clones are EET 575 and EET 576 adaptad for the central part of Manabí, an important cacao growing zone with a rainfall nearing 1000 mm. The clones EET 544 and EET 558 are also part of the group of clones recently released. These are adapted to the zone of Chongon and related areas marked by a precipitation that is quite concentrated and ranging anually from 300 to 500 mm. This zone is a new frontier to grow cacao under irrigation. Before their release the new clones were compared simultaneously to CCN 51 under irrigation during the dry season for several years. The conclusion was that there are no statistical yield differences between these new Nacional type clones and the CCN 51 variety.

From these results it is clear that opportunities do exist to select genotypes equipped with enough genetic potential for further development and release as fine or flavor cacao varieties. When these are subjected to increasing levels of technical management, including irrigation and cultural disease control practices, turned into highly productive cacao fields. Hence the mith stating that all Nacional type cacao cultivars yield poor is beginning to be scientifically questioned. Establishment of large demonstration plots and the availability of enough qualified planting material will help to improve the rate of adoption for these new fine or flavor cacao varieties.

Multiplication of recomended varieties

Though additional efforts are required to demonstrate in a commercial scale the qualities of the new varieties, demand of qualified planting material is on the rise largely fueled by government programs which are promoting the planting of cacao of the Naciona type. The objective is to keep and reinforce the world presence of Ecuador as the main supplier of fine or flavor cacao.

INIAP provides some 600,000 plants of Nacional type clones annually. However,this quantity is not sufficient to meet the current demand and has created a problem of transparency within the market of planting material. Several private nurseries that sell Nacional type plants have emerged in the past few years. These have dificulties to demonstrate that the planting material is of the Nacional type. Besides, the process of selling plants has many intermediaries, a factor that aggravates the problem and generates growing claims.

The search for alternatives to overcome this bottleneck is a pending task for INIAP. We are betting in the use of the somatic embriogenesis technology to increase the supply of qualified planting material of the Nacional type in the future substantially. In fact, after proving that the clonal plants originated by this technology perform much better (higher yield, precouciousness, better growth pattern, etc.) than those produced through the tradional methods of cloning, we just recently established a clonal garden with these type of plants and and more gardens are planned for establishmente in the next future. Expectations are that we could be able to multiply by four the current INIAP´s capacity to deliver clonal planting material to farmers.

Additionally, a mechanism is also under discussion to authorize the functioning and monitoring of private nurseries to produce and offer qualified Nacional type material, as long as these are duly supervised and certified by a goverment instance after checking through genetic profiles that the material being sold conforms to the genetic make up of the recommended Nacional type clones.

FARMER PARTICIPATORY SELECTION ACTIVITIES

Farm surveys

Visiting cacao farms is always an enriching experience because of the oportunities that show up to learn from vusal observations and talks to farmers about their perception on the yield variability of the trees tha make up the cacao field , the factors that most limit yield from thieir particular perspective, and others issues. A survey was carried out to extract information and know the opinion of the cacao farmers about selected agro-socio-economic issues influencing the traditional cacao producing process in their holdings.

Three distinct cacao growing zones were selected to apply the survey to farmers growing cacao. To name the zones geological ang geografic references were used: 1) LLanura aluviales (Floodplains), Pie de Monte (Piedmont of the western part of the

Andean range) and Esmeraldas norte (near to the Colombian border). These zones are responsible for two thirds of the total cacao production in Ecuador. 30 farmers were surveyed in each zone. The analysis of the information collected revealed differences on their socio-economic situation and technical challenges they face during the process of cacao production (See Table 1).

The following stand out as the main conclusions: 1) Producers of the Alluvial plain zone, technologically speaking, are ahead from the cacao growers in other zones, as many of them do furrow irrigation doubling or tripling the average yield for the country; However, the farmers' average age is the highest (≥ 55 years); 2) The producers in the Piedmont zone show the highest literacy level (≥ 6 years at school) and showed the highest interest regarding the introduction of new varieties and innovating management techonology, including irrigation if high yield varieties are available; 3) The lowest average age corresponds to farmers in the zone of Esmeraldas norte and also showed a great enthusiasm at the time of discussing about new management tecnologies to increase the cacao yield, though they also have the least literacy level; 4) In all zone most farmers (86%) share the idea about the diseases representing the greatest limiting factor of cacao yield, placing drought as the second limiting factor (40%), and 4) But in general, most showed a genuine interest to be part of participative research processes to evaluate and identify improved cacao varieties adapted to the zone where they live.

These conclusions represent valuable inputs to be taken into account at the moment of assigning resources (time, personnel, money, and so on) to invest in research, technology transfer, training, credit programs and others development tools to promote the production of fine or flavor cacao varieties. Thus they stand out as an important output of the project allowing a better viewing of the scenario and challenges that embrace the cacao production in Ecuador.

Farm selections

The development of the CFC/ICCO/IPGRI and CFC/ICCO/Bioversity International projects were fruitful regarding the gathering of new cacao acessions that morphological conforms to the Nacional variety type. These collections feeded on the germplasm bank held by the E. Pichilingue making it larger and hopefull richer in genetic diversity. Budsticks from the trees selected in farmer´s fields were used to fix their genetic traits through clonal multiplication. Furtherly, the multiplied planting material was used to set up observation plots usually made up of 5 to 10 plants per plot.

These introductions represent genetic resources for future evaluation and identification of clones having a particular combination of traits to justify a further development as commercial varieties. After all, the clones currently recommended (EET 103, EET 96, EET 95, EET 48, EET 575, EET 576, EET 544 y EET 558) for commercial use by INIAP come from early selections made in traditional farmer´s fields along different cacao growing zones.

This gathering activity was better planned and conducted during the CFC/ICCO/Bioversity project, as a key part of its central concept based on a participative research approach with the inclusion of producers to improve the process of selection of useful genotypes. Together with each farm´s owner a total of 12 farms were visited in the three surveyed zones. The main output of this activity was the identification of 84 superior cacao trees. Budsticks were gradually collected from these to obtain clones and and thus fixed their genetic attributes.

Esmeraldas norte was the zone where more cacao farms were visited and more trees were identified for further cloning. The greater emphasis placed in this zone responded to our interest to find trees that exhibited phenological traits resembling Criollo cacao types to widen the genetic basis of our germplasm bank and explore the posibility of developing in the long run a Criollo type variety adapted to the Esmeraldas norte zone. Trees showing the Criollo type phenology have been frequently sighted in earlier crossings of this zone.

This objetive was largely attained representing another important project´s output. At the time of writing up this report all the collected material is set up in the field and undergoing evaluation. It is expected that the end of the evaluation process we will be able to select genotypes equipped with a particular combination of attributes to justify their further development as commercial fine and flavor cacao varieties.

To complement this collecting activity of interesting Criollo type genotypes a modest fraction of the funds allocated to the CFC/ICCO/Bioversity International project were used in late 2008 to explore a relatively remote area of the Cayapas-Onzone river basin in the zone of Esmeraldas norte. This was a joint cooperative search with another local project that also shared this objetive. More than 300 accessions (clones and seeds) were gathered. The collected material was set up as observations plots made up of 5 to 10 plants at the E. Pichilingue. A partial duplicate is held by the University of Esmeraldas.

We can conclude that both projects, particularly the CFC/ICCO/Bioversity project have been generous in opportunities to search, identify and gather cacao genotypes of interest in different farmer´s fields. This is certainly another important output of the research efforts sheltered by this project which contributed to widen the genetic variability of the germplam bank held by INIAP for the genetic improvement of the crop. One of the objetives of the Esmeraldas norte collection is in the long run to work toward the development of fine or flavor Criollo type cacao varieties adapted to this particular zone (See Tables 2, 3 and 4).

Pruebas clonales en fincas de productores

All the 84 trees selected during the survey in different farmer´s fields of the Alluvial Plains, Piedmont and Esmeraldas norte zones were multiplied as clones and introduced to the E. Pichilingue as observation plots to study their performance. Naturally, these introductions have enriched the genetic variability of the germplasm bank with the benefits it will bring for the future of the breeding of fine or flavor cacao varieties in

Ecuador. The next step will be a genetic characterization of these accessions to estimate the extent of the variability that has been added to the bank and developed their capacity of use for breeding and selection.

Only 25 of the 84 selected trees are participating as clonal treatments in farmer´s field trials together with experimental clones of INIAP. These trials were established in the areas of Las Naves (Piedmont zone), Moraspungo (Piedmont zone), Milagro (Alluvial Plain zones), Simon Bolivar (Alluvial Plane zone), Colon Eloy (Esmeraldas norte zone) and Muisne (Esmeraldas sur zone) and are currently under evaluation.

The zone of Esmeraldas sur was not considered initially for the survey though it does share some of the agro-socio-economic characteristics of the Esmeraldas norte zone. Our decision to set up a participative trial in this zone was based on our interest to expand the inferences of the results and add informative value to the ongoing project. However, due to distinct causes (poor collaboration of the owner of the farm, plant destruction by vehicles, domestic animals and herbicides applied in nearby crops, heavy traffic of people, and so on) the number of plants of the trial was cut down drastically while the number of empty sites due to non survivig plants grew more and more. Suviving plants were also afected by excesive variability in growth. Research ativities were finally discontinued at this site because we were going nowhere with this situation.

So far results emerging from these trials, particularly those of the areas of Colon Eloy (Esmeraldas norte) and Simon Bolivar (Alluvial Plains) look particularl promising for the future selection of genotypes adapted to both zones. Within the next two or three years we may be ready to make final selections to release cultivars that can be of commercial interest.

A formal experiment including all 25 clones which are participating in the distinct farmer´s trials is currently conducted at the E. Pichilingue. The clone named Las Naves 8, coming from a tree selected in a farm of the Piedmont zone, stand out clearly from the others due to the large number of harvested pods per tree. Two large replicated plots are in the process of being planted to this clone to monitor its performance and that of other interesting cultivars set up in the same site. Some of these are clones of hybrid trees selected from hybrid families produced and planted during the CFC/ICCO/IPGRI project but the evaluation was completed under the umbrella of the CFC/ICCO/Bioversity International project (See Tables 5, 6, 7, 8, 9 and 10).

ON STATION BREEDING EFFORTS

Clone Selection

Beggining 1999 several clone comparison trials were estblished as part of the CFC/ICCO/IPGRI project. All were kept under evaluation until the first three years of the CFC/ICCO/Bioversity International project, though as we know the focus of this project was on participative research with the inclusion of producers. Research funding is always insufficient but we did find ways to stretch and complement the resources allocated by CFC with those of other sources. This way we kept these trials ongoing for a number of years until we had accumulated a sufficient amount of data to arrive at a valid conclusion.

The different clonal comparison trials were assigned the following names: International Clone Trial; 2) Local Clone trial (I); 3) Local Clone Trial (II), 4) Observation plots for Nacional type plants and their parental trees; 5) Trial to compare populations of Nacional cacao type under normal and high planting density; 6) Study of the effect of the roostock on the induced vigor to the scion. Tables 11, 12, 13, 14,15 and 16 illustrate the main results in each case.

Regarding the international clones introduced to evaluate their local performance and adaptation, none yielded higher than CCN 51 and EET 103 used as controls. The clone CCN 51positioned itself far away from the rest and almost double the yield of EET 103 which preceded it. It is important to underline the low incidence of witches´ broom (vegetative and cushion) shown by CCN 51demonstrating its good level of disease resistance to this disease. However, we can not say the same regarding moniliasis as have been observed in several instances. After corresponding lab and field tests the clones IMC 47 and VENCE 4 were classified as resistant to the "Mal del Machete" disease. The clone EET 59 showed a important level of Moniliasis resistance that should be exploted for breeding. All the clones in this trial were also characterized for sensorial traits (See Table 17).

The main conclusion based on the results of the so called "Local clone trials" point out that none of the commercial or experimental clones compared to CCN 51perform better than this regarding yield or disease resistance. In the best case the yield difference was 70% in favor of CCN 51 and in the worst case this clone yielded several times higher than the lowest yielding Nacional type clones. The highest yielding Nacional type clones that preceded CCN 51were EET 103 and EET 575.

EET 575 was realeased as a comercial clone in 2009 due to its good adaptation to an important cacao growing zone. More important it shows a yield level that is comparable to that of CCN 51under irrigation conditions. This is supported by the results of a trial where CCN 51, EET 575 and other clones were tested simultaneously for a number of years. It should be noted at this time that CCN 51 performs better that any Nacional type clone with no irrigation. It exhibits some drought resistance possibly as an expression of a osmotic adaptation mechanism to this strees condition. Apparently, the Nacional type clones do not show this physiological adaptation thus being more susceptible to water strees as has been observed.

On the other hand, the comparison of plants derived from seeds of pods harvested in selected trees identified in traditional cacao fields to the clones of the same trees, revealed that these always yielded higher that their clones. These result seems to provide additional evidence with respect to the fact that clones derived from apparently superior trees are not a guarantee of good performance for reasons that we will not discuss here. However, the treatment made up of the mixture of the clones EET 103, EET 95, EET 96 and EET 62 recommended by INIAP for commercial planting showed the highest yield compared to any other treatment demostrating why they are improved Nacional type varieties.

The results of other trial suggested that yield can be cut by 50% when the planting density is doubled to 2,200 plants per hectare as compared to the normal density (1,100 plants per hectare) possibly due to extreme resource competition, aggravated by drought. This result is possibly certain as well for other cacao growing areas. It would be interesting to know what will happen if intermediate density levels are tested. Will the yield increase or decrease?. We need to clarify that plants are derived from seeds.

Pruning effect was also measured in the same study but the yield difference between prunned and unprunned plots showed no statistical significance, though pruning did cause a slight yield decrease. Since these are seed derived plants it is correct to pose the question about what the response will be for clonal plants subjected to several levels of planting density and pruning. An additional pruning study concluded in 2008 clearly showed a gradual depressive effect on yield by increasing the intensity of this practice. A 25% pruning level did not reduced yield suggesting that light pruning works fine for cacao as compared to drastic pruning (See Table 18 and 19).

Another study to explore the differences among clones for the rates of flowering, setting of fruits, fruits affected by cherelle wilt, diseased pods and final dry bean weight was completed in 2009. Results showed significative statistical differences (See Table 20). CCN 51 produced three times more flowers than EET 103. However, the percentage of flowers setting fruits in the clone EET 103 was twice that of CCN 51. This result is in agreement with previous findings showing that the number of flowers does not represent a yield limiting factor in cacao.

In the same study CCN 51 and EET 103 were the highest yielding clones though CCN 51 yielded twice compared to EET 103 (See Table 21). Averaging through all clones we found that only 54 flowers per tree were able to set fruits, that is to say 19% of all the flowers produced. Some 45% of the fruits were afected by the problem of cherelle wilt. Only 32% of the fruits developed and riped normally up to harvest while 20% of the them reached harvest time as diseased pods.

The effect of the rootstock vigor on the growth and yield of the scion of two clones, EET 103 and CCN 51, was also studied. No clear differences in yield were detected in response to this factor for any of the two clones. However, we need to clarify that the quality of the data was afected by excessive variability in the number of plants per plot since many did not survive. Replication of the trial to confirm these results is strongly suggested.

As we can see from the above paragraphs the project generated a generous amount of information regarding several commercial and experimental clones, making an important contribution for a better understanding of the technical problems anchoring cacao productivity. It is clear that these results have opened avenues to build up new work hypothesis to guide future research efforts to improve the agronomy and the genetic base of the cacao crop.

Hybrid selection

As part of the work plan for the project CFC/ICCO/IPGRI, several trials to compare groups of hybrid families were established beginning 1998. These originated from crossing schemes duly discused, formulated and executed between the local cacao team and the international project coordinator. A couple of trials that started earlier than 1998 were incorporated in the project work plan to continue their evaluation. Most of the trials were kept under evaluation until 2008, well into the period of execution of the project CFC/ICCO/Biodiversity International, though as we know its focus was more on participative research with the inclusion of producers to improve the effectiveness of the selection process.

Under the umbrella of the CFC/ICCO/Biodiversity International project a last trial to compare hybrid families was planted in 2009, including as breeding parents the selections made in some experiments completed in the period 2007-2008. The recombination of genetic traits associated to high yield, disease resistance and sensorial quality is the main objective. This trial will be conducted during the next six years to make additional selections of superior trees which will be further cloned.

Among other activities that started in early 2008 and even early 2010 under the umbrella of the CFC/ICCO/Bioversity International project, we have the planting of two new experiments to compare groups of clones derived from superior trees selected in the distinct hybrid trials conducted and completed earlier (See photos in the corresponding Annex). The objective of both trials is to select clones that best reflect the favorable traits of the trees they came from and show promise to pursue their further development as commercial varieties.

We have to recognized that research funds are always scarce. However, we found ways to complement funding from different sources, including the CFC/ICCO/IPGRI, to make progress in our breeding objectives. Maintainace and data registration for most of the trials that started during this project continue for a sufficient number of years to achieve results leading to valid final conclusions. The CFC/ICCO/Bioversity project provided a vital support to complete the evaluation and analysis.

The following names were assigned to the different hybrid trials: 1) Comparison of 18 cacao hybrid families of the Nacional type in the zone of Quevedo; 2) Comparison of 21 cacao hybrif families of the Nacional type in the zone of Quevedo; 3) Comparison of 16 cacao hybrid families obtained by crossing parentals showing disease resistance and high yielding traits; 4) Comparison of 16 hybrid families obtained by crossing Nacional type promising clones equipped with disease resistance to witches´broom; 5) Comparison of 12 hybrid and selfed families obtained by crossing several Nacional type clones, including CCN 51; 6) Comparison of 20 hybrid families obtained by crossing selected Nacional type cacao clones showing disease resistance and high yielding potential; 7) Comparison of selfed cacao progenies of clones that were used as parents in different crossing schemes; 8) Comparison of non inoculated and inoculated asyntomatic plants regarding witches´ broom incidence and belonging to the same hybrid family; 9) Comparison of hybrid families obtained by crossing homocigous clones of the Nacional variety with cothers showing a high degree of heterocigocity; 10) Comparison of different hybrid families produced and sent by the countries participating in the project; 11) Evaluation of the hybrid family (EET 183 x Pound 7) x UF 273) introduced from Costa Rica to participate in a study to analyze the stability of QTL´s; 12) Comparison of clones of hybrid trees selected for disease resistance and yield performance, Trial I; 13) Comparison of clones of hybrid trees selected for disease resistance and yield performance, Trial II; 14) Comparison of a group of clones planted in large replicated plots (100 plants) of trees selected for disease resistance and high yielding traits.

Tables 22, 23, 24, 25, 26, 27, 28, 29, 30, 31 and 32 contain relevant results of most of the trails. Some have been established recently (2008-2010) and that is why no results are reported but data registration has begun. Table 33 contains sensorial evaluation data of pulp and cotyledon of an numerous amount of hybrid trees to test that hypothesis that flavor quality traits can be predicted from testing of the pulp (and possibly the cotyledon too). It is astonishing to see how large the flavor variability of the fresh beans is for the trees tested and sensorial traits measured.

A number of selections have been been made from the different trials completed during the span of the CFC/ICCO/Bioversity International project, among them the ones originated in families of the following crosses: CCAT 2119 x CCAT 4668; EET 451 x EET 387; CCN 51 x CCAT 2119; EET 445 x EET 400; EET 416 x EET 400; EET 445 x CCN 51; EET 426 x EET 387, EET 446 x EET 547; EET 578 x EET 547; EET 48 x EET 95; EET 451 x EET 387; CCN 51 x EET 387; CCN 51 x EET 233; CCN 51 x EET 416; CCN 51 x EET 233; CCN 51 x EET 387; EET 416 x EET 534; EET 559 x CCN 51; EET 575 x EET 462.

As stated earlier most of these selectiones have already been cloned to participate in new clone comparison trials established in the period 2008-2010. See Table 34 for the most recently established experiment (March 2010). It is expected that within the next 5 or 6 years these trials will be the source of new fine or flavor cacao varieties. Since these are being conducted at the Estación Pichilingue the first beneficiaries will be the cacao producers of the zone of Quevedo where up to 1/3 of the total cacao exports originates.

LESSONS LEARNED

To find the righ balance among the different resources(funds, trained people, time, land, etc.) that take part in any research process is certainly a difficult task. We should reognized this was a great challenge we could not meet in some situations. Talking about new avenues and pieces of research was not a problem. But putting them into practice within an environment of scarcity of resources created more than a difficulty. In this context financial shortness was just one factor we had to face. Ohers had to do with the insuficient level of training of the people taking part in the project, as well as the availability of needed expertise and the time availability of the scarce scientific staff.

Under our educational system those working toward a agronomist degree must complete and defend a piece of research. So we recruited students that finished university studies to manage the different trials and register data. They used this data to write up a research report (Thesis) and graduate. But they needed training and close supervision that demanded a important amount of time of the few senior researchers available before they were able to show some level of autonomy. Most of the time there were other cocoa research projects on quality, agronomy and technology transfer ongoing at the same time, putting a lot of pressure on the time resource provided by the scientists with some experienece. Sometimes there was no time to share.

Administrative issues and transferring of personnel also turned into obstacles on the road limiting progress in the cocoa research activities, not only of those under the umbrella of the CFC/ICCO/Bioversity International project, but of other projects conducted simultaneously. In short, several challenges were confronted but most of them were finally overcome. We learned that reaching a adequate balance for research sources was dificult but both the CFC/ICCO/IPGRI and CFC/ICCO/Bioversity International projects, provided us with opportunities to gain valuable experience. We should also recognized an important weakness: lack of publications in scientific journals.

CONCLUSIONS

Impact of the CFC/ICCO/Bioversity project

Both, the CFC/ICCO/IPGRI and CFC/ICCO/Bioversity International projects were a key factor to re-launch cocoa breeding research in Ecuador discontinued since mid 1970´s.

New germplasm collections, breeding populations and clone selections obtained during the scope of this international collaboration effort represent a strong platform for future release of genetically improved varieties for the benefit of the cacao producers. These project outputs articulate nicely into a strategic plan INIAP is preparing to guide the development of superior varieties, placing emphasis on fine and flavor cacaos, for the next 25 years.

It is important to note that some selections made during the last CFC/ICCO/Bioversity International project are already being tested in main cocoa growing regions. Besides, six clones multiplied from selected best hybrids trees identified in distinct hybrid families comparison trials have been recently (early 2010) established and replicated as 100 plants plots at the E. Pichilingue. Demostration and future release of at least a couple of fine or flavor cacao varieties is the main objective.

Training of local people in scientific, technical and conceptual skills, to visualize, formulate, conduct and evaluate breeding and selection processes, also represent a valuable output derived from this and the previous CFC/ICCO/IPGRI project. In this context, three of the several students that conducted pieces of research in the frame of both projects were incorporated as part of the INIAP staff. Others are working as cacao agronomist in the private sector. Additionally, the experience developed as part of the different project activities have turned into an important input for the Program of Cacao staff when the time comes for advising or participating in the formulation of other local cacao projects regarding research and technology transfer, as well as taking part in their execution.

Perspectives

The outputs by both CFC/ICCO/IPGRI and CFC/ICCO/Bioversity International projects (collected germplasm, enrichment of variability, hybrid populations, selection of best hybrid trees, availability of promising clones, farmer´s field trials, staff experience, international links, etc.) are being built into a strategic plan that INIAP is giving shape to gradually produce and release genetically improved fine or flavor cacao varieties for the next 25 years, as well as for improving the agronomy that should go along with these. It is expected that irrigation studies on cacao will become an important line of research to develop most of the potential of future high yielding cultivars. After all almost half of the producers that provided answers for the survey conducted in three distinct cacao growing zones mentioned drought as a limiting factor following cacao diseases which stands as first.

Within a six month time a field day will take place to show advances in the technology of getting somatic embriogenic plants as well as setting up the first clonal garden to promote an alternative method of clonal multiplication. This will hopefully help to get a substantial increase in the supply of qualified planting material for the production of fine or flavor cacao. In the medium term this technology will turn into an important tool to distribute genetically improved cacao varieties for commercial planting.

A cacao field day is being planned to take place within a year from now to release two new Nacional type clones with "Arriba" flavor. This will be recommended for the south eastern part of the Guayas river basin, an important cacao growing zone. It is also expected that in a three years time from now, at least a couple of additional Nacional type clones, products of the CFC/INIAP/Bioversity International project, will be added to the recommended comercial cultivars for the same zone.

In a similar period of time we expect to release new varieties for the zone of Esmeraldas norte. At most in a six years time from now a cacao field day will take place to release new commercial fine or flavor cacao varieties adapted to the central (Quevedo zone) and northern part of the Guayas river basin, which together produces 40% of the total cacao exports. We may in a 12 years time be ready to release new fine or flavor cacao flavor varieties adapted to the northern ecuadorian Amazonía, a expanding border for this crop. We plan to multiply and send selections of this project to the Amazonian region in the near future.

Meanwhile the breeding work will continue to keep on feeding the hybrid population base for selection and developmente of new cacao varieties. In this line of thought a F2 hybrid population was produced in 2009 and a formal trial was set up early in 2010 for evaluation. It is expected to begin a backcrossing work to increase the frequency of favorable alleles in selected hybrid trees in the near future.

In great measure the contribution to the increased capacity of the local cacao research team to set up a work basis and then formulate a vision to develop this resourse base into improved fine or flavor cacao varieties, accompanied by the best agronomy practices, is by itself the most important project output.

Publication and events during the course of the project

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ANNEX

Table # 1. Number of interesting trees selected in cocoa farms visited in the surveyed zones.

Zone	# of Farms Surveyed	# of Selected tress
Alluvial plains	2	10
Piedmont	4	20
Esmeraldas	6	54

Table # 2. Number of trees multiplied as clones to take part in participative research plots with farmer's inclusion in distinct cocoa growing zones.

Zone	# of trees multiplied as clones
Alluvial plains	7
Piedmont	10
Esmeraldas	8

Table # 3. Top 10 highest yielding clones present in the collection made up of cacao genotypes selected in farms from distinct cocoa growing zones of the coastal region

Clone	Fresh bean weight, g	Healthy Pods	Diseased Pods	Cherelle witt Affected fruits	Vegetative witches's Broom	Pod Index	Seed Index
Naves-6	8358	44	12	105	6	-	-
Naves-8	8327	52	6	144	3	24	1.19
JHV-10 (Control)	3703	23	3	37	1	-	-
Naves-7	3455	22	2	83	3	-	-
CCN-51 (Control)	3332	16	7	100	1	-	-
Naves-5	3160	24	6	89	2	-	-
Naves-46	2343	25	3	68	1	-	-
Esmeraldas-16	1750	15	2	60	1	-	-
Esmeraldas-58	1412	12	1	14	1	-	-
Echeandia-71	1198	16	1	42	0	-	-

* Data are accumulated values per tree for the period January 2008 – April 2010 (28 months)
Planting date: May/2006
Number of plants per accession: 5

Table # 4. Criollo type and other cacao genotypes collected during the second semester of 2008 in surveyed farms along the Cayapas – Onzole river basin, in the northern zone of the province of Esmeraldas (Esmeraldas norte)

Number of accessions		Number of		Planting date
Seeds	Clones	hybrid plants per plot	clonal plants per plot	
146	196	5	5	January 2009

Table # 5. On farm trials to compare selected cocoa trees from farmer's fields and INIAP's genetic material

Zone	# of treatm.	# of plants per plot	Surface (ha)	Planting date	Comments
Alluvial plains	30	5	0.33	November 2006	Ongoing
Alluvial plains	29	5	0.18	December 2006	Ongoing
Alluvial plains	20	20	0.72	March 2008	Ongoing
Piedmont	30	5	0.33	February 2006	Ongoing
Piedmont	20	9	0.41	September 2007	Ongoing
Esmeraldas norte	31	5	0.41	May 2006	*Ongoing
Esmeraldas sur	31	5	0.41	April 2006	Discontinued

* Affected by a moderate varibility within plots.

Table # 6. Top 10 highest yielding cocoa clones in a trial to compare INIAP's genotypes and farmer's genotypes at Estación Experimental Tropical Pichilingue.

Genotypes	Fresh Bean Weight, g	Healthy Pods	Diseased Pods	"Cherelle Wilt" Fruits	Vegetative Witches broom
CCN-51 x EET-462	3030	23	2	83	3
EET-446 x CCN-51	2787	25	2	76	2
PA-107	2175	21	1	19	2
CCN-51 x EET-233	2068	18	0	26	5
CCN-51	2064	12	2	44	1
A-2126	1765	22	3	31	3
CCAT-1119	1728	16	4	53	5
CCN-51 x EET-387	1239	13	3	28	4
CCN-51 x CCAT-2119	1172	11	0	27	2
A-2634	1167	11	1	25	2

. Data are values accumulated per tree during the period January 2008 – April 2010 (2 Reps.)
. Planting date: May/2006

Table # 7. Number of healthy and diseased pods from a participative cocoa research trial conducted in the area of Colon Eloy, Esmeraldas norte zone (accumulated from December 2008-September 2009).

Nº	Clone	Total Pod Number	
		Healthy	Diseased
1	CCAT -4668	12	105
2	CCAT - 3345	46	153
3	CCAT - 2143	84	170
4	CCAT - 1119 (544)	63	295
5	CCAT - 2564	41	260
6	EET - 454 (558)	34	49
7	A-2126	116	302
8	A-2634	78	180
9	A-2748	44	309
10	EET-454 x EET-400 E1/T15/R4/A9	119	384
11	CCN-51 x CCAT-2119 E1/T11/R4/A10	67	18
12	EET-446 x CCN-51 E2/T9/R2/A8	121	434
13	EET-426 x CCN-51 E2/T2/R1/A8	102	184
14	CCN-51 x EET-233 E4/T4/R4/A4	116	97
15	CCN-51 x EET-387 E4/T8/R4/A4	121	655
16	CCN-51 x EET-462 E5/T5/R3/A1	136	198
17	CCN-51 x EET-534 E5/T2/R3/A2	32	229
18	CCN-51 x EET-450 E1,2,3/T7/R4/A9	40	215
19	PA-107	116	217
20	D-1 Domingo Baltazar	1	17
21	D-7 Domingo Baltazar	5	10
22	D-16 Domingo Baltazar	49	154
23	D-18 Domingo Baltazar	3	28
24	B-12 Auria Valencia	1	1
25	B-13 Auria Valencia	1	4
26	B-3 Auria Valencia	0	4
27	B-9 Auria Valencia	18	171
28	EET-103 (T1)	43	362
29	CCN-51 (T2)	91	265
30	JHV-10 (T3)	32	97
31	EET-575	6	179
	Average	**56**	**185**

Planting date: May 24 / 2006

Table # 8. Number of healthy and diseased pods from a participative cocoa research trial conducted in the area of Las Naves, Piedmont zone (accumulated from November-December 2008 and April - October 2009)

Nº	Clone	Total Pod Number	
		Healthy	Diseased
1	CCAT -4668	1	0
2	CCAT - 3345	5	14
3	CCAT - 2143	9	1
4	CCAT - 1119	0	0
5	CCAT - 2564	0	0
6	EET - 454	0	0
7	A-2126	37	25
8	A-2634	3	0
9	A-2748	0	0
10	EET-454 x EET-400 E1/T15/R4/A9	9	24
11	CCN-51 x CCAT-2119 E1/T11/R4/A10	0	0
12	EET-446 x CCN-51 E2/T9/R2/A8	50	17
13	EET-426 x CCN-51 E2/T2/R1/A8	0	0
14	CCN-51 x EET-233 E4/T4/R4/A4	12	0
15	CCN-51 x EET-387 E4/T8/R4/A4	3	8
16	CCN-51 x EET-462 E5/T5/R3/A1	19	18
17	CCN-51 x EET-534 E5/T2/R3/A2	27	9
18	CCN-51 x EET-450 E1,2,3/T7/R4/A9	10	4
19	PA-107	20	7
20	70 Echeandia (Zona Centro)	2	2
21	99 Echeandia (Zona Centro)	6	3
22	002 Las Naves/Cristina Verdezoto (Zona Centro)	21	5
23	037 Las Naves/Cristina Verdezoto (Zona Centro)	0	0
24	044 Las Naves/Cristina Verdezoto (Zona Centro)	2	15
25	046 Las Naves/Cristina Verdezoto (Zona Centro)	73	20
26	056 Las Naves/Carlos Portilla (Zona Centro)	10	7
27	067 Las Naves/Rodrigo Yanez (Zona Centro)	0	0
28	EET-103 (T1)	12	24
29	CCN-51 (T2)	12	3
30	JHV-10 (T3)	3	1
	Average	**11**	**7**

Planting date: February 7 / 2006

Table # 9. Number of healthy and diseased pods from a participative cocoa research trial conducted in the area of Milagro, Alluvial plains (accumulated from September 2008- July 2009).

Nº	Clone	Total Pod Number	
		Healthy	Diseased
1	CCAT -4668	27	20
2	CCAT - 3345	24	29
3	CCAT - 2143	0	0
4	CCAT - 1119 (544)	13	3
5	CCAT - 2564	10	9
6	EET - 454 (558)	1	0
7	A-2126	66	26
8	A-2634	54	18
9	A-2748	30	37
10	EET-454 x EET-400 E1/T15/R4/A9	15	7
11	CCN-51 x CCAT-2119 E1/T11/R4/A10	7	2
12	EET-446 x CCN-51 E2/T9/R2/A8	192	68
13	EET-426 x CCN-51 E2/T2/R1/A8	5	3
14	CCN-51 x EET-233 E4/T4/R4/A4	57	6
15	CCN-51 x EET-387 E4/T8/R4/A4	45	28
16	CCN-51 x EET-462 E5/T5/R3/A1	77	51
17	CCN-51 x EET-534 E5/T2/R3/A2	44	48
18	CCN-51 x EET-450 E1,2,3/T7/R4/A9	4	12
19	PA-107	22	19
20	8 Hilda Martínez (Zona Sur Llanura)	2	2
21	15 Catalino Bermello (Zona Sur Llanura)	11	31
22	16 Catalino Bermello (Zona Sur Llanura)	0	0
23	25 Pedro Granizo (Zona Sur Llanura)	1	1
24	26 Luis Granizo (Zona Sur Llanura)	0	0
25	35 Aurelio Castro (Zona Sur Llanura)	0	0
26	36 Marina Verdezoto (Zona Sur Llanura)	0	2
27	37 Marina Verdezoto (Zona Sur Llanura)	0	1
28	EET-103 (T1)	35	48
29	CCN-51 (T2)	42	19
30	JHV-10 (T3)	29	22
	Average	27	1

Planting date: November 22 y 23/ 2006

Table # 10. Number of healthy and diseased pods from a participative cocoa research trial conducted in the area of Simon Bolivar, Alluvial plains zone (accumulated from November 2008- July 2009)

Nº	Clone	Total Pod Number	
		Healthy	Diseased
3	EET-446 x EET-400 E1/T10/R4/A8	89	45
5	EET-577 x EET-578 E1/T16/R4/A2	0	0
6	EET-454 x EET-400 E1/T15/R4/A9	25	13
7	EET-446 x EET-378 E1/T6/R2/A2	34	5
8	EET-451 x EET-378 E1/T8/R1/A3	69	8
9	CCN-51 x CCAT-2119 E1/T11/R4	0	0
10	EET-446 x EET-400 E1/T10/R1/A8	23	13
11	CCN-51 x CCAT-2119 E1/T11/R4/A8	0	0
12	CCN-51 x CCAT-2119 E1/T11/R4/A4	2	2
15	EET-446 x CCN-51 E2/T9/R2/A2	11	5
16	EET-426 x EET-378 E2/T5/R2/A1	5	8
17	EET-462 x EET-233 E4/T2/R4/A3	11	12
18	CCN-51 x EET-233 E4/T4/R1/A2	55	9
19	EET-416 x EET-233 E4/T1/R3/A2	5	0
20	CCN-51 x EET-378 E4/T8/R5/A4	3	8
21	CCN-51 x EET-233 E4/T4/R1/A3	17	6
22	CCN-51 x EET-387 E4/T8/R1/A4	3	1
23	CCN-51 x EET-387 E4/T8/R4/A2	3	0
25	EET-446 x EET-387 E4/T6/R4/A8	13	12
26	EET-454 x EET-387 E2/T16/R2/A3	4	2
28	EET-446 x CCN-51 E2/T9/R2/A8	49	15
29	EET-426 x CCN-51 E2/T2/R1/A3	29	23
30	EET-578 x EET-547 E3/T3/R2/A7	15	8
31	CCN-51 x EET-534 E5/T2/R2/A1	19	7
32	CCN-51 x EET-416 E5/T3/R3/A12	56	20
33	CCN-51 xEET-462 E5/T5/R3/A1	0	3
39	CCN-51 x EET-450 E5/T2/R4/A3	20	6
41	CCN-51 (T1)	9	26
42	EET-103 (T2)	0	6
	Average	**20**	**9**

Planting date: December 15/ 2006

Table # 11. Accumulated values per tree for several yield and sanitary variables registered during the period 2002-2007. International clone trial. (Planting date: April/2000).

Clone	Numbers of pods		% Diseased pods	N° of Witches' broom		Witchess' broom weight, g**	Index		Accumulated dry bean weight, kg 2004-2007	Productive efficiency, g/cm² 2007
	Healthy	Diseased		Vegetative	Cushion*		Pod, 2007	Seed, 2007		
CCN-51	87	50	36	8	0	15	12	1,4	4,75	9,95
EET-103	57	42	42	37	16	153	23	1,2	2,02	3,21
IMC-47	58	33	36	18	3	60	25	0,9	1,89	3,83
PA-107	54	36	40	14	0	28	20	1	1,82	4,32
MAN-15-2	37	21	36	64	26	174	22	0,9	1,34	2,25
EET-59	30	26	46	53	24	169	19	1,4	1,33	1,79
AMAZ-15-15	36	25	41	21	0	79	19	1	1,29	3,88
ESPEC-54-1	35	23	40	30	0	75	26	1,1	1,22	1,80
PLAYA ALTA-2	27	17	39	11	0	29	19	1,4	1,08	1,47
UF-676	21	20	49	79	50	201	17	1,7	1,08	2,27
GU-175	24	16	40	40	0	93	18	1	0,97	2,03
CATIE-1000	22	16	42	45	16	99	26	0,8	0,76	2,07
ICS-43	13	14	52	52	67	123	17	1,7	0,67	1,19
VENCE-4	10	16	62	68	27	71	18	1,1	0,41	0,81
SCA-6	18	16	47	23	3	111	32	0,6	0,36	0,50
EQX-3360-3	8	5	38	11	23	9	25	1	0,32	0,63
PA-120	7	6	46	25	0	26	22	1,1	0,30	0,87
GU-255	6	3	33	11	12	17	27	-	0,17	0,56
BE-10	4	4	50	44	0	39	22	-	0,16	0,57
LCT-EEN-46	7	4	36	10	0	12	32	-	0,16	0,32
LCT-EEN-37	4	6	60	12	0	12	20	1	0,16	0,69
VENCE-22	5	4	44	45	0	90	37	-	0,14	0,42
LAF-1	3	4	57	37	25	124	19	-	0,12	0,40
MXC-67	1	1	50	10	0	14	-	-	0,03	-
Average	24	17	44	32	12	76	22	1,13	0,94	2,0

* Registered during the period 2005-2006.

** Registered only in 2002.

Table # 12. Accumulated values per tree for several yield and sanitary variables registered during the period 2002-2007. Clone trial I. (Planting date: December/1999).

Clone	Number of pods		% Diseased Pods	Number of witches's broom		PI***	Accumulated dry bean, kg 2004-2007	Productive efficiency, g/cm² 2005
	Healthy	Diseased		Vegetative*	Cushion**			
CCN-51	95	54	36	10	0	16	5,09	20,86
EET-95	64	49	43	30	1	21	2,41	15,55
EET-96	60	54	47	29	1	24	2,30	14,73
EET-103	56	40	42	32	1	23	2,26	11,82
EET-62	55	55	50	29	1	22	2,23	14,92
EET-552	63	52	45	30	1	24	2,18	7,6
EET-547	55	33	38	31	0	26	1,96	11,99
EET-574	60	66	52	20	0	24	1,95	12,82
EET-577	50	48	49	25	1	22	1,94	13,28
EET-48	50	46	48	31	4	23	1,84	12,21
EET-513	54	22	29	24	0	33	1,64	7,78
EET-19	36	31	46	33	1	21	1,59	8,39
EET-578	46	43	48	30	1	26	1,56	11,67
EET-534	23	13	36	13	0	23	1,01	7,16
Average	55	43	44	26	1	23	2,14	12,20

* Accumulated during 2003 y 2007.

** Registered only in I 2003.

*** Pod index calculated in 2005.

Table # 13. Accumulated values per tree for several yield and sanitary variables registered during the period 2003-2008. Clone Trial II. (Planting date: May/2001).

Clone	Number of pods		% Diseased Pods	Number of witches's broom		Witches's broom weight, g***	Cherelle wilt fruits ****	PI *****	Dry bean weight, kg 2004-2008	Productive efficiency, g/cm² 2008
	Healthy	Diseased		Vegetative*	Cushion**					
CCN-51	66	39	37	15	4	2	55	14	4,19	49,16
EET-576	52	41	44	46	3	10	33	17	2,47	27,79
EET-513	63	22	26	33	2	2	18	29	2,01	14,41
EET-103	40	23	37	32	1	1	32	19	1,93	33,74
EET-575	38	37	49	50	2	4	25	17	1,91	33,09
EET-544	39	37	49	25	1	4	38	22	1,64	33,61
EET-559	43	46	52	25	1	2	25	24	1,64	23,13
EET238xSCA-12	46	32	41	33	3	5	30	28	1,59	19,86
EET-525	33	17	34	36	1	0	19	25	1,20	33,12
EET-538	22	17	44	20	1	0	14	21	0,96	19,06
EET-510	21	14	40	47	1	2	22	21	0,81	11,23
T. CARRANZA	15	8	35	33	2	0	13	20	0,81	13,25
EB-27-02	7	13	65	24	1	1	15	16	0,38	9,86
EET-522	6	4	40	40	1	0	6	27	0,23	3,96
Average	35	25	42	33	2	2	25	21	1,55	23,23

* Registered during the period 2002-2008.
** Accumulated during 2003 and 2008.
*** Registered in 2002.
**** Registered in l 2008.
***** Pod index calculated in 2008

Table # 14. Accumulated values per tree for several yield and sanitary variables registered during the period 2002-2008. Trial to compare natural hybrids trees to their respective clones. (Planting date: April/2000).

Treatment	Number of pods		% Diseased pods	N° witches's broom		Witches's broom weight, g***	PI ****	Acumulated dry bean weight, kg 2004-2008	Adjusted accumulated dry bean weight, kg***** 2004-2008	Productive efficiency g/cm², 2008
	Healthy	Diseased		Vegetative*	Cushion **					
Hib.Sebastian Arteaga	51	40	42	120	1	147	20	1,91	2,54	6,75
Clon Sebastián Arteaga	4	3	43	39	0	20	19	0,20	0,32	0,61
Hib.TeolindaCarranza	46	21	31	79	1	94	18	1,90	2,68	7,29
Clon Teolinda Carranza	38	25	39	93	1	48	19	1,60	1,96	2,88
Hib.Voluntad de Dios	35	21	38	118	1	105	18	1,45	1,51	5,18
Clon Voluntad de Dios	9	9	50	96	1	75	20	0,35	0,45	1,28
Hib.La Lolita	43	22	33	96	2	107	20	1,71	2,56	5,57
Clon	27	16	37	78	1	71	22	1,09	1,16	2,90
Hib.EET-578xEET-552	46	28	38	98	1	20	23	1,75	2,0	6,49
Mezcla de clones: EET-62, EET-95, EET-96, EET-103	70	67	49	122	1	40	18	3,20	3,84	6,58
Average	37	25	40	94	1	73	20	1,52	1,90	4,55

* Registered during the 2001-2008.
** registered only in l 2003.
*** 2001 and 2002 accumulated date.
***** Pod index calculated in 2008.
***** Adjusted yield data according the potential number of plants (48) per plot.

Table # 15. Accumulated values per tree for several yield and sanitary variables registered during the period 2002-2008. Trial to compare natural hybrids trees to their respective clones as influenced by levels of pruning and planting distance. (Planting date: July/2000).

Hybrid tree origin Treatment	Number of pods		% Diseased pods	Number of witches' broom		Vegetative witches' broom weight**	PI ***	Accumulated dry bean weight, kg 2004-2008	Adjusted accumulated dry bean weight, kg **** 2004-2008	Productive efficiency, g/cm², 2008
	Healthy	Diseased		Vegetative	Cushion*					
S. Arteaga, sin poda, densidad normal	56	25	31	64	1	54	20	1,70	2,26	10,2
S. Arteaga, sin podar, alta densidad	25	16	39	62	1	38	18	0,84	1,51	5,6
S. Arteaga, con poda, densidad normal	46	22	32	70	1	64	20	1,60	3,2	10,1
S. Arteaga, con poda, alta densidad	19	13	41	62	1	46	19	0,67	1,02	4,9
Vol. Dios, sin podar, densidad normal	40	25	38	62	1	56	18	1,33	1,59	5,2
V. Dios, sin podar, alta densidad	20	10	33	46	1	51	17	0,74	1,02	6,7
Vol. Dios, con poda, densidad normal	36	23	39	72	0	11	19	1,32	1,58	6,4
V. Dios, con poda, alta densidad	14	7	33	54	1	36	17	0,59	0,83	3,7
Average	30	17	36	60	1	42	18	1,02	1,62	6,1

* Registered in 2003
** Registered only in 2002
*** Pod index calculated in 2008
**** Adjusted yield according to the potential number of plants per plot (3) at normal distance and 72 plants for the high density planting.

Table # 16. Accumulated values per tree for several yield and sanitary variables registered during the period 2004-2008. Trial to compare the effect of low and high vigour roostock on selected clones. (Planting date: April/2000).

Treatment	Number of pods		% Diseased pods	Number of vegetative witche's broom	Cherelle wilt fruits*	PI **	Dry bean weight, kg 2004-2008	Adjusted acumulated dry bean weight, Kg*** 2004-2008	Productive efficiency g/cm². 2008
	Healthy	Diseased							
CCN-51 injertado en EET-26 (Vigor alto)	68	54	44	19	7	17	2,90	4,14	8,83
CCN-51 injertado en IMC-67xCatongo (Vigor medio)	73	49	40	20	5	14	3,80	9,5	12,07
CCN-51 injertado en EET-55 (Vigor bajo)	64	52	45	29	6	15	2,90	3,86	11,73
EET-103 injertado en EET-26 (Vigor alto)	59	46	44	49	4	21	2,16	2,97	9,31
EET-103 injertado en IMC-67xCatongo (Vigor medio)	60	47	44	55	7	24	1,77	2,72	6,67
EET-103 injertado en EET-55 (Vigor bajo)	61	45	42	57	3	21	1,93	3,21	9,04
Semilla del patrón de Vigor alto	16	8	33	16	1	21	0,66	1,1	7,49
Semilla del patrón de Vigor medio	62	21	25	21	4	16	2,58	2,86	20,01
Semilla del patrón de Vigor bajo	27	18	40	19	6	20	1,08	1,54	10,78
Average	54	38	40	32	5	19	2,20	3,54	10,66

* Registered in 2008
** Pod index calculated in I 2008.
*** Adjusted yield according to the potential number of plants plot.

Table # 17. Sensorial results* for 20 genotypes subjected to a comparison study as part of the International Clone Trial.

Clone	Floral	Frutal	Nutty	Cocoa	Bitter	Astringency	Acidity	Raw
UF- 676	1,0	1,5	0,0	3,0	3,8	5,3	5,0	3,0
MAN-15-2	2,5	1,5	0,3	4,0	2,3	3,8	3,5	0,0
SPEC- 54-1	0,3	2,7	1,0	3,3	2,5	4,3	3,0	0,0
AMAZ-15-15	3,0	1,0	2,5	0,0	2,8	2,8	3,3	0,5
ICS – 43	1,0	1,0	0,5	3,2	4,5	5,0	5,0	3,3
SCA – 6	1,0	3,0	0,0	4,0	2,0	2,5	3,5	0,0
PA – 107	3,5	0,8	1,3	3,3	3,2	3,3	2,5	2,0
EQX – 3360	0,0	0,0	0,0	1,5	5,0	6,0	3,5	2,0
IMC – 47	2,0	2,0	1,0	4,0	3,0	3,5	5,0	2,0
GU – 175	2,0	3,7	1,5	4,2	2,3	2,9	2,8	0,3
EET – 59	1,3	1,2	1,3	3,7	2,5	3,2	4,2	1,0
CATIE - 1000	0,0	3,0	0,0	2,5	2,0	2,5	4,0	0,0
PA - 120	2,0	0,0	1,5	4,0	3,5	3,0	2,5	0,0
VENCE - 22	0,0	4,0	2,0	3,0	2,0	2,0	3,0	0,0
VENCE – 4	2,8	2,0	2,0	1,3	3,3	4,0	3,0	0,5
BE – 10	0,0	0,0	2,0	2,5	2,5	3,5	2,0	1,0
PLAYA ALTA 2	0,2	2,8	1,5	3,0	3,8	4,8	4,0	1,7
LCT - ENN - 37	3,0	1,0	0,0	3,5	4,5	3,5	4,0	1,0
EET – 103	3,2	1,2	0,5	3,7	3,5	4,2	3,7	1,0
CCN – 51	0,0	2,0	0,0	3,3	5,0	5,8	5,2	2,8

* Average of three replications

Note: The scale used to quantify sensorial perceptions is 0 – 10

Table # 18. Influence of pruning intensity on yielding and sanitary performance of cacao* during the period October 2007 – November 2008.

Pruning Intensity**	Dry bean Yield/tree (kg)	# Healthy Pods/tree	# of disease Pods/tree	Potential Yield/tree (kg)	# Vegetative Witches broom/tree
25%	0.84 a	19 a	20 a	1.60 a	27
50%	0.68 ab	16 a	16 ab	1.20 ab	19
75%	0.58 b	12 b	12 b	1.06 b	18

* An 8 year old clonal cocoa field

** Percentage of the top of the tree

Table # 19. Influence of pruning intensity on yielding and sanitary performance of cocoa* during the period October 2007 – November 2008.

Pruning Intensity**	Dry bean Yield/tree (kg)	# Healthy Pods/tree	# of disease Pods/tree	% of healthy Pods tree (kg)	# of vegetative witches broom/tree
0 %	1.10	26	26	47	28
25%	0.98	22	22	35	26
50%	0.53	16	16	35	16
75%	0.55	12	12	35	9

* An 12 year old clonal cocoa field

** Percentage of the top of the tree.

Table # 20. Comparison of flowering and fructification dynamics for a group of Nacional type clones* vs. CCN-51 during 2008.

Clone	# Opened Flowers	Flowers that Set fruits	Fruits affected By Cherelle Wilt	Diseased Pods	Healthy Pods
EET 575	450 ab	63 bc	21 abc	21 a	21 bcd
EET 525	187 bc	62 bc	26 ab	19 abc	23 abc
EET 559	387 abc	55 d	22 abc	12 abc	24 abc
EET 544	182 bc	66 bc	38 a	16 ab	22 abc
EET 576	399 abc	69 b	26 ab	17 ab	25 abc
EET 513	276 bc	53 d	18 c	7 bc	28 ab
EET 510	250 bc	36 f	20 abc	7 bc	12 bcd
EET 538	373 bc	43 e	21 abc	6 bc	19 bcd
EET 522	131 c	19 g	13 c	3 c	4 d
EB-27-02	257 bc	39 ef	20 abc	11 abc	7 cd
T. Carranza	339 bc	40 ef	21 abc	4 c	15 bcd
Arbol 2183	243 bc	63 bc	24 ab	12 abc	28 ab
EET 103	201 bc	58 cd	22 abc	7 bc	30 ab
CCN-51	642 a	85 a	28 a	18 ab	39 a
Average	305	52.8 (17.3%)	20 (37.8%)	11.4 (21.6)	212 (40.1%)

* An 8 year old clonal cocoa field.

Table # 21. Yield, sanitary and morphological data per tree registered during May 2007 to March 2009 for a group of Nacional type clones compared to CCN-51.*

N °	Clone	Dry vean weight kg	Pod number			% Diseased pods	Witches' broom		Productive efficiency, kg/cm^2	Crown shape (verticality)*
			Healthy	Diseased	Cherelle Wilt fruits		Vegetative	Cushion		
1	EET- 575	1.45 bc	25.54 abcde	20.03 ab	44.12 bcd	53.2	30.46 ab	2.13 a	0.04 abc	1.76 bcd
2	EET- 525	0.88 bcde	23.41 bcde	13.24 cdef	43.44 bcd	36.13	25.80 abc	1.50 ab	0.02 bc	2.02 b
3	EET- 559	1.25 bcd	30.65 abc	35.07 a	53.49 ab	53.36	18.87 bcd	0.89 cd	0.03 abc	1.58 bcde
4	EET- 544	1.14 bcd	24.61 bcde	24.30 abcd	61.63 a	49.69	16.96 cd	0.99 cd	0.02 bc	1.48 cde
5	EET- 576	1.64 b	29.85 abc	31.31 ab	54.01 ab	51.2	31.21 ab	1.82 a	0.03 abc	1.43 cde
6	EET- 513	1.16 bcd	33.45 ab	11.84 def	40.87 cd	26.14	20.49 bc	1.16 bc	0.02 cd	1.78 bc
7	EET- 510	0.58 def	13.69 efg	10.67 def	41.20 cd	43.8	37.98 a	1.70 ab	0.01 d	1.52 cde
8	EET- 538	0.71 def	15.48 defg	11.01 def	37.77 d	41.55	16.44 cd	0.91 cd	0.02 cd	1.59 bcde
9	EET- 522	0.25 f	6.57 g	5.50 f	37.32 d	45.57	39.17 a	1.17 bc	0.002 d	1.31 e
10	EB -27- 02	0.39 ef	6.93 fg	12.48 def	41.95 bcd	64.29	18.79 bcd	0.83 cd	0.01 d	1.47 cde
11	T Carranza	0.80 cdef	16.63 cdef	7.60 ef	43.22 bcd	31.36	27.06 abc	1.19 bc	0.02 cd	1.41 cde
12	Árbol 2183	1.21 bcd	31.36 abc	27.65 abc	45.34 bcd	46.86	23.38 bc	1.82 a	0.03 abc	1.35 de
13	EET- 103	1.48 bc	29.47 abcd	18.52 bcde	49.86 abc	38.58	22.38 bc	0.94 cd	0.04 ab	1.53 cde
14	CCN - 51	2.93 a	44.37 a	27.37 abc	58.53 a	38.15	9.97 d	2.81 a	0.05 a	2.91 a
	Average	0.99	23.71	18.97	46.62		24.21	1.42	0.02	1.65
	F. Cal.	**	**	**	**		**	ns	**	**
	C.V. (%)	10.85	19.99	21.9	7.89		15.92	19.6	0.54	5.04

* Yield, pod and witches' broom data are accumulated during the period of registration.

** Verticality was measured using a 1 -3 scale (1 = horizontal; 2 = medium; 3 = vertical)

Table # 22. Accumulated values per tree for several yield and sanitary variables registered during the period 2001-2006. Trial to compare a group of cacao hybrid families. (Planting date: August/1998).

Hybrid family	Number of pods		% diseased pods	Number of vegetative witches' broom	Accumulated dry bean weight, kg (2001-2006)	Adjusted acumulated dry bean weight, kg (2001-2006)	PI (2006)	Prodcutive efficiency g/cm2, 2006
	Healthy	Diseased						
CCAT-21-19x EET-574	38	16	29	12	1,10	1,12	32	2,50
CCAT-21-19x EET-577	26	10	27	16	0,70	0,80	34	1,81
CCAT-21-19x EET-578	33	9	21	15	1,05	1,07	32	1,70
CCN-51 x CCAT-21-19	55	19	25	9	1,91	2,72	27	3,56
EET-445x CCAT-21-19	34	13	27	12	0,90	0,97	31	1,07
EET-445x EET-400	55	24	30	12	1,73	1,92	29	3,52
EET-446x EET-387	56	19	25	11	1,75	1,84	28	2,66
EET-446x EET-400	86	30	25	17	2,59	4,14	30	4,63
EET-451x EET-387	57	22	27	11	1,84	2,04	29	4,25
EET-454x CCAT-21-19	28	13	31	16	0,97	1,21	27	2,02
EET-454x EET-400	50	22	30	8	1,88	2,50	23	4,13
EET-454x EET-578	34	17	33	12	1,18	1,21	28	3,30
EET-547x EET-574	15	11	42	14	0,45	0,75	25	1,27
EET-547x EET-578	29	14	32	14	0,90	1,02	33	1,85
EET-574x EET-577	24	22	47	11	0,74	0,84	29	2,51
EET-574x EET-578	34	21	38	7	1,03	1,42	32	3,22
EET-577 x EET-574	29	25	46	10	0,87	0,99	37	2,03
EET-577x EET-578	32	21	39	11	1,11	1,16	28	2,40
Average	40	18	32	12	1,26	1,54	29	2,75

* Adjusted dry bean weight according to the potential number of plants (40) per plot.

Table # 23. Accumulated values per tree for several yield and sanitary variables registered during the period 2001-2007. Trial to compare a group of cacao hybrid families. (Planting date: April/1999).

Hybrid family	Number of pods		% Diseased pods	Number of vegetative witches' broom	Cherelle wilt fruits (2006)	Accumulated dry bean weight, kg (2001-2006)	Adjusted dry bean weight, kg (2001-2006)**	PI (2006)	Productive efficiency g/cm2.2006
	Healthy	Diseased							
CCN - 51 Semilla (testigo 2)	21	11	34	4	2	0,88	1,60	6	1,94
EET-103 X EET-387 (Testigo 1)	27	13	32	7	2	0,77	1,20	11	1,43
EET-416 X EET-400	34	13	27	6	1	1,23	1,75	6	3,33
EET-426 X CCN - 51	44	24	35	9	2	1,87	3,25	5	1,80
EET-426 X EET-233	47	18	27	9	2	1,79	2,86	7	3,33
EET-426 X EET-387	33	20	37	9	2	1,09	1,61	7	1,70
EET-426 X EET-547	35	14	28	8	2	1,15	1,76	8	1,86
EET-426 X EET-578	30	13	43	6	5	0,95	1,35	9	1,78
EET-445 X CCN - 51	31	12	28	9	2	1,10	1,91	4	1,11
EET-445 X EET-578	24	9	27	7	2	0,83	1,27	6	1,15
EET-446 X CCN - 51	42	20	32	5	3	1,51	2,15	6	1,87
EET-446 X EET-547	30	16	34	9	2	0,82	1,21	7	1,01
EET-451 X EET-574	21	18	46	4	2	0,69	1,38	6	1,08
EET-451 X EET-578	26	21	44	10	2	0,92	2,04	9	1,35
EET-452 X CCN - 51	29	17	37	10	5	1,22	1,95	8	2,46
EET-454 X CCN - 51	32	17	34	8	2	1,20	1,77	8	2,24
EET-454 X EET-387	37	20	35	12	1	1,57	2,24	8	3,53
EET-454 X EET-574	25	14	35	6	2	0,83	1,22	9	1,52
EET-454 X EET-577	23	13	36	8	1	0,79	1,26	8	1,26
EET-577 X EET-233	29	22	43	11	1	0,94	2,20	5	0,69
EET-577 X EET-400	16	9	36	12	1	0,55	1,36	8	0,81
Average	32	16	35	8	8	1,08	1,78	7	1,84

* All variables were registered up to 2007, with the exception of the dry bean weight and number of cherelle wilt fruits. Both were registered in the period 2001- 2006 and 2006, respectively.

** Adjusted yield according to the potential number of plants per plot

Table # 24. Accumulated values per tree for several yield and sanitary variables registered during the period 2002-2007. Trial to compare a group of cacao hybrid families. (Planting date: January/2000).

Hybrid families	Numer of pods		% Diseased pods	Number of vegetative witches' broom	Accumulated dry bean weight, kg (2002-2006)	Adjusted accumulated dry bean weight, kg (2002-2006)	PI (2006)	Productive efficiency g/cm2, 2006
	Healthy	Diseased						
CCN - 51 Autopolinizacion (testigo)	23	13	36	73	1957,32	0,8	21	9,34
EET-19 x EET-48	20	13	39	72	1611,32	0,6	29	6,51
EET-48 x EET-95	34	23	40	98	2590,52	1,06	31	11,29
EET-547x EET-534	27	14	34	76	1767,44	0,81	32	12,33
EET-552x EET-513	29	17	37	83	2080,91	0,88	29	9,07
EET-552x EET-534	19	13	40	72	1382,36	0,66	30	7,27
EET-552x EET-547	22	11	33	66	1545,25	0,68	31	7,08
EET-574x EET-513	20	17	45	82	1570,63	0,68	27	7,68
EET-574x EET-534	37	29	43	110	2762,14	1,27	28	16,97
EET-574x EET-547	42	24	36	103	3133,81	1,38	28	16,97
EET-574x EET-577	34	24	41	98	2467,62	1,13	32	12,16
EET-577x EET-513	25	13	34	72	1631,91	0,79	30	8,02
EET-577x EET-534	44	20	31	95	3078,51	1,36	30	19,79
EET-577x EET-547	36	21	37	94	2646,51	1,17	29	15,22
EET-578x EET-547	48	37	43	128	3861,88	1,63	29	18,46
EET-62 x EET-103	35	21	37	93	2506,64	1,13	31	10,89
Average	31	20	38	88	2287	1,00	29	11,82

* Adjusted yield according to the potential number (50) of plants per plot.

Table # 25. Accumulated values per tree for several yield and sanitary variables registered during the period 2002-2007. Trial to compare a group of cacao hybrid families. (Planting date: January/2000).

Hybrid families	Number of pods		% Diseased pods	Number of vegetative witches' broom	Accumulated dry bean weight, kg (2002-2006)	Adjusted accumulated dry bean weight, kg* (2002-2006)	PI (2006)	Productive efficiency g/cm2, 2006
	Healthy	Diseased						
CCN - 51 Autopolinización(testigo)	19	13	40	17	89,64	0,86	19	2,60
CCN - 51 x EET-233	68	29	29	46	171,76	3,14	24	7,39
CCN - 51 x EET-387	35	22	38	84	179,13	1,68	19	5,29
CCN - 51 x EET-534	47	25	34	25	130,62	1,97	23	7,67
EET- 387 x EET-534	17	13	43	45	118,47	0,79	24	3,24
EET- 452 x EET-534	25	21	45	50	140,18	1,03	23	3,68
EET-233 x EET-387	21	14	40	66	141,66	1,07	24	2,67
EET-416x EET-233	27	18	40	56	141,56	1,07	24	3,13
EET-416x EET-387	26	23	47	47	144,06	1,16	23	3,57
EET-416x EET-534	23	14	37	21	94,26	0,94	23	3,12
EET-450x EET-387	26	14	35	57	131,54	1,13	24	3,68
EET-450x EET-534	28	15	34	32	108,97	1,11	27	2,71
EET-452x EET-233	31	24	43	55	152,15	1,26	26	3,21
EET-462x EET-233	21	21	50	40	131,64	0,91	27	2,72
EET-462x EET-387	16	16	50	46	128,64	0,71	22	2,52
EET-462x EET-534	29	26	47	25	126,26	1,09	30	4,00
Average	29	19	41	45	133,16	1,25	24	3,82

* Adjusted yield according to the potential number (50) of plants per plot

Table # 28. Accumulated values per tree for several yield and sanitary variables registered during the period 2003-2008. Trial to compare a group of selfed hybrid families. (Planting date: May/2000).

Hybrid families	Number of pods		% Diseased pods	Number of vegetative witches' broom	Cherelle wilt fruits(2008)	Accumulated dry bean weight, kg (2004-2008)	Adjusted dry bean weight, kg* (2004-2008)	PI(2008)
	Healthy	Diseased						
CCN-51 x CCN-51	36	22	38	11	7	1,72	2,64	17
EET-574 x EET-574	20	19	41	23	9	0,73	0,97	24
EET-103 x EET-103	23	16	39	16	8	0,91	1,01	24
EET-233 x EET-233	20	7	26	18	9	0,74	0,98	26
EET-452 x EET-452	16	20	55	17	6	0,67	1,11	18
EET-534 x EET-534	17	11	42	13	3	0,53	0,72	20
EET-577 x EET-577	21	16	43	25	8	0,83	1,27	22
Average	22	16	42	18	7	0,85	1,24	22

* Adjusted yield according to the potential number (20) of plants per plot.

Table # 29 . Accumulated values per tree for several yield and sanitary variables registered during the period 202 – 2008 to compare a group of hybrid families..

Hybrid population	Treatment	Family	Pod number		% Diseased pods	Number of vegetative witches' broom	Cherelle wilt fruits (2008)	Accumulated dry bean weight, kg (2004-2008)	Ad, kg (2004-2008)*	PI (2008)
			Healthy	Diseased						
1.2.1	Inoculated	CCA-46-68 x CCAT-18-48	14	25	64	105	6	0,52	0,78	21
1.2.1	Inoculated	CCAT-46-68 x EB-22-25	26	23	47	20	19	1,09	1,25	25
1.2.1	Inoculated	CCAT-49-98 x CCAT-18-58	56	34	37	10	33	2,49	2,80	21
1.2.1	Inoculated	EET-19 x EET-48	46	39	45	28	15	2,37	4,74	19
1.2.1	Non Inoculated	CCA-46-68 x CCAT-18-48	17	33	66	27	5	0,68	0,81	19
1.2.1	Non Inoculated	CCAT-46-68 x EB-22-25	26	19	42	15	23	0,96	1,80	31
1.2.1	Non Inoculated	CCAT-49-98 x CCAT-18-58	45	42	48	23	32	2,22	4,99	27
1.2.2	Inoculated	CCN-51 x EB-22-25	46	38	45	66	30	1,99	3,31	21
1.2.2	Inoculated	CCN-51 x EET-233	45	52	53	16	15	2,26	2,82	19
1.2.2	Inoculated	CCN-51 x EET-387	35	42	54	104	6	1,22	2,74	18
1.2.2	Non Inoculated	CCN-51 x EB-22-25	27	34	55	17	21	1,26	2,10	21
1.2.2	Non Inoculated	CCN-51 x EET-233	55	33	37	20	38	2,77	4,15	18
1.2.2	Non Inoculated	CCN-51 x EET-387	49	40	45	124	11	1,84	2,36	19
1.2.3	Inoculated	CCN-51 x EET-416	70	43	38	69	5	3,43	4,57	15
1.2.3	Inoculated	CCN-51 x ET-450	83	49	37	95	7	3,46	4,03	21
1.2.3	Inoculated	CCN-51 x ET-451	39	19	32	13	57	1,58	2,63	19
1.2.3	Inoculated	CCN-51 x ET-462	37	70	65	32	9	1,44	1,92	20
1.2.3	Inoculated	EET-450 x EET-416	27	17	38	50	5	1,13	1,43	21
1.2.3	Inoculated	EET-451 x EET-450	37	28	43	12	2	2,05	4,1	29
1.2.3	Inoculated	EET-462 x EET-450	19	12	38	28	3	0,74	1,29	26
1.2.3	Non Inoculated	CCN-51 x EET-416	98	57	36	43	17	4,65	5,81	18
1.2.3	Non Inoculated	CCN-51 x ET-450	55	41	42	91	11	2,42	3,08	19
1.2.3	Non Inoculated	CCN-51 x ET-451	51	27	34	11	27	3,13	6,26	14
1.2.3	Non Inoculated	CCN-51 x ET-462	68	114	62	56	48	2,23	4,46	21
1.2.3	Non Inoculated	EET-450 x EET-416	23	29	55	34	3	1,00	1,16	17
1.2.3	Non Inoculated	EET-451 x EET-450	19	16	45	19	3	0,92	1,84	11
1.2.3	Non Inoculated	EET-462 x EET-450	21	27	56	55	5	1,04	2,42	17
Average			42	37	47	44	17	1,89	2,950	20

* Adjusted yield data for the potential number (   ) of plants per plot.

Planting date: March / 2000

Table # 30. Accumulated values per tree for several yield and sanitary variables registered during the period 2006 – 2009 to compare a group of hybrid families.

Hybrid familiy	Pod number		% Diseased pods	Number of vegetative witches' broom	Accumulated dry bean weight, kg 2006-2008	Adjusted accumulated dry bean weight, kg 2006-2008	PI (2009)	Productive efficiency g/cm2, 2008
	Healthy	Diseased						
11802 x SA -8	4	2	33	11	0,21	0,42	19	2,41
11802 x TC - 2	7	1	12	20	0,31	0,49	24	3,06
CCN - 34 x SA - 8	7	3	30	31	0,34	0,54	16	2,97
CCN - 34 x TC - 2	9	3	25	17	0,45	0,72	19	3,78
CCN - 51 x SA - 8	12	3	20	14	0,61	0,97	20	5,05
CCN - 51x EET-117	10	2	17	15	0,45	0,81	22	6,51
EB - 15 - 16 x SA-8	4	1	20	18	0,17	0,31	23	1,80
EB - 15 - 16 x TC-2	5	1	17	27	0,15	0,31	28	1,67
EET - 17 x SA - 8	4	1	20	19	0,17	0,25	20	3,00
EET - 446 x CCN-51 Autp. (T2)	6	1	14	4	0,26	0,61	22	4,03
EET - 95 x EET-332 (T1)	9	2	18	26	0,36	0,72	24	4,25
EET-17 x TC-2	1	0	0	15	0,04	0,06	25	0,60
EF - 168 x SA - 8	10	4	28	34	0,44	0,76	21	4,60
LCT - 46 x TC - 2	5	0	0	12	0,18	0,27	27	3,06
LCT - EEN - 371 x SA - 8	7	2	22	16	0,35	0,46	22	8,25
LCT - EEN - 371 x TC-2	5	1	17	21	0,24	0,35	21	3,06
SA - 8 x TC - 2	8	1	11	29	0,26	0,42	28	2,28
SIAL - 70 x SA - 8	8	2	20	25	0,35	0,56	22	3,10
SIAL - 70 x TC - 2	5	1	17	45	0,18	0,29	28	2,16
SIC - 250 x TC - 2	21	4	16	49	0,73	1,21	28	6,56
SM - 8 x SA - 8	3	1	25	21	0,12	0,22	24	1,52
SM - 8 x TC - 2	6	2	25	29	0,23	0,34	24	2,73
TAP - 11 x SA - 8	10	2	17	18	0,43	0,61	23	6,66
TAP - 11 x TC - 2	13	4	23	17	0,55	0,84	22	5,73
TC - 2 x SA - 8	5	1	17	20	0,20	0,33	24	3,36
TIP - 4 x TC - 2	4	1	20	15	0,19	0,33	25	3,09
TIP-4 x SA-8	4	1	20	11	0,10	0,2	32	1,83
UF - 168 x TC - 2	9	1	10	58	0,30	0,52	32	2,78
Average	7	2	18	23	0,30	0,50	24	3,57

* Adjusted yield data for the potential number ( ) of plants per plot.

Table # 31 . Accumulated values per tree for several yield and sanitary variables registered during the period 2006 – 2009 for a group of hybrids families coming from different American cocoa growing countries.

Hybrid family	Pods number		% Diseased pods	Number of vegetative witches' broom*	Number of Cherelle wilt fruits (2007-2009)	Accumulated dry bean weight, kg 2006-2009	Adjusted accumulated dry bean weight, kg 2006-2009**	PI (2008)	Productive efficiency g/cm2, 2008
	Healthy	Diseased							
(EET-233xEET-399) x IMC-67 (ECUADOR-QTL)	27	2	6	48	20	1,20	1,8	20	10,90
(IMC-67xU-68) x U-1(Perú)	6	1	14	11	10	0,28	0,57	17	4,32
CC-137 x EET-399 (Costa Rica)	22	4	15	39	24	0,94	1,61	21	11,02
CCN-51 x CC-137 (Costa Rica)	32	4	11	85	22	1,59	2,38	20	2,56
CCN-51 x EET-233 (Perú)	6	0	0	6	3	0,25	0,88	20	14,16
CCN-51 x TAP-12 (Ecuador-Testigo)	34	6	15	21	32	1,84	3,06	18	12,78
CCN-51 x TSH-1188 (Brasil)	7	0	0	11	12	0,25	0,75	18	15,90
CCN-51xTSH-1188 (Trinidad)	5	0	0	9	7	0,31	0,8	24	15,65
CP-40 x CP-87 (Brasil)	27	3	10	25	18	1,42	2,24	17	6,58
CP-52 x CCN-10 (Brasil)	15	1	6	16	14	0,63	1,4	23	2,78
EET-103 x EET-387 (Ecuador-Testigo)	16	3	16	43	16	0,64	1,01	24	3,78
EET-183xPOUNDxUF-273(ARBOL 45 ISLA 3 Costa Rica)	9	1	1	72	15	0,35	0,51	26	1,57
EET-233 x U-1(Perú)	6	0	0	7	11	0,24	0,51	26	8,72
EET-95 x EET-332 (Ecuador-Testigo)	6	2	25	40	13	0,30	0,43	20	12,31
GU 154 x ICS-43 (Costa Rica)	38	4	9	61	27	1,88	2,68	20	9,43
IMC-67 x U-68 x ICS-95 (Perú)	5	0	0	13	8	0,20	0,34	22	14,48
PA-169 x TRD-32 (Trinidad)	36	7	16	45	20	1,62	2,7	19	4,43
TSM-973 x ICS-95 (Trinidad)	32	3	8	51	19	1,49	2,98	19	4,52
UB-184 x CP-50 (Brasil)	27	3	10	43	28	1,12	2,92	23	8,69
VENEZUELA SIN IDENTIFICACION.	28	2	6	33	18	1,29	1,93	20	8,86
Average	19	2	8	34	17	0,89	1,58	21	8,67

* Registered during the period 2006-2009

** Adjusted accumulated yield according to the potential number (60) of plants per plot.

Table # 32. Accumulted values per tree for several yield and sanitary variables registered during the period 2008 – 2009 on the hybrid family EET-183 x (POUND-7 x UF-273) Arbol-45, as part of a QTL stability study in several countries.

Plant N°	Pod Number		% Diseased pods	Number vegetative witches' broom	Accumulated dry bean weight, kg (2008-2009)	Cherelle wilt fruits (2008-2009)	PI (2009)	Productive efficiency, g/cm², 2009
	Healthy	Diseased						
1	0	0	0	11	0	0		
6	0	0	0	2	0	0		
7	0	0	0	7	0	20		
9	0	0	0	3	0	0		
10	4	0	0	6	0,14	1	29	4,22
11	3	0	0	13	0,10	20	30	3,54
12	21	7	25	16	1,06	40	20	29,46
14	34	0	0	10	1,14	13	38	5,89
16	2	0	0	7	0,06	3	33	1,75
17	0	0	0	2	0	0		
18	30	0	0	4	0,94	18	50	2,14
21	0	0	0	9	0	4		
25	4	0	0	0	0,16	0	25	17,62
31	3	0	0	0	0,08	0	38	23,10
34	0	0	0	1	0	0		
35	0	1		4	0	3		
37	0	0	0	1	0	2		
42	1	2	66	7	0,02	0	50	0,55
43	24	2	7	30	1,47	49	15	24,21
44	0	0	0	4	0	0		
45	31	2	6	83	1,7	46	19	22,92
47	6	2	25	5	0,14	24	67	1,29
51	2	1	33	6	0,12	8	17	4,24
52	26	0	0	35	1,12	61	22	17,68
53	0	0	0	2	0	0		
58	32	8	20	33	1,36	10	24	19,01
60	5	0	0	19	0,24	42	25	3,51
61	12	0	0	10	0,58	36	19	4,68
62	0	0	0	6	0	5		
65	0	1		29	0	4		
67	26	2	7	20	1,13	28	23	30,14
68	6	1	14	6	0,22	11	27	6,63
71	1	0	0	5	0,04	2	25	1,13
74	7	0	0	2	0,18	49	50	2,53
76	0	0	0	0	0	0		
80	0	0	0	5	0	0		
83	0	0	0	0	0	0		
93	0	0	0	1	0	1		
94	8	0	0	22	0,2	14	56	2,41
95	7	0	0	3	0,1	2	70	4,37
97	2	0	0	18	0,06	3	33	1,65
98	0	0	0	38	0	23	50	
103	13	0	0	2	0,26	3		5,73
104	0	0	0	36	0	3		
106	2	8	80	24	0,06	22	33	1,11

109	16	0	0	24	0,67	10	33	2,09
110	0	0	0	1	0	0		
114	19	11	36	14	0,9	56	21	14,81
116	16	0	0	7	0,49	35	33	6,61
117	6	0	0	6	0,14	50	43	4,09
118	24	0	0	6	0,672	38	34	13,44
119	13	1	7	0	0,4	97	29	11,14
120	1	0	0	10	0,04	0		
121	0	0	0	12	0	3		
122	0	0	0	9	0	18		
124	0	0	0	3	0	0		
128	0	0	0	5	0	0		
129	0	0	0	2	0	0		
132	0	0	0	4	0	30		
135	13	2	13	21	0,56	0	26	6,94
136	2	0	0	26	0,03	0	67	1,14
138	0	0	0	6	0	1		
140	0	0	0	3	0	1		
148	0	0	0	2	0	0		
151	0	0	0	0	0	0		
159	2	0	0	14	0,12	0	17	5,05
160	7	0	0	8	0,18	0	39	8,81
161	0	0	0	1	0	4		
162	16	1	5	4	0,388	0	43	16,70
163	0	0	0	1	0	0		
164	0	0	0	1	0	4		
167	0	0	0	1	0	20		
169	15	3	16	9	0,668	0	22	18,39
171	1	0	0	4	0,04	23		
175	11	1	8	22	0,378	2	38	5,16
178	22	1	4	10	0,8	0	13	5,30
179	0	0	0	28	0	0		
180	0	0	0	5	0	0		
181	1	0	0	4	0,02	2	50	0,84
182	0	0	0	7	0	0		
185	0	0	0	3	0	0		
189	0	0	0	1	0	0		
193	0	0	0	3	0	0		
196	0	0	0	0	0	0		
198	0	0	0	2	0	0		
199	0	0	0	2	0	0		
201	1	1	50	2	0,04	0	25	6,50
207	0	0	0	2	0	0		
212	0	0	0	0	0	0		
220	31	0	0	11	0,97	0	32	18,68
221	0	0	0	1	0	0		
222	0	0	0	7	0	0		
223	0	0	0	1	0	10		
225	1	1	50	23	0,06	15	17	1,56
226	13	0	0	19	0,52	20	33	4,96
227	27	5	15	34	1,17	1	33	3,62
232	4	0	0	0	0,18	10	22	9,17

233	14	0	0	11	0,58	1	24	18,03
236	0	0	0	3	0	1		
237	0	0	0	0	0	0		
239	0	0	0	0	0	0		
241	16	6	27	14	0,72	3	22	21,05
242	9	0	0	15	0,22	0	41	7,29
243	0	0	0	1	0	0		
246	8	0	0	0	0,28	0	29	19,28
248	0	0	0	2	0	0		
249	0	0	0	5	0	0		
251	0	0	0	0	0	0		
254	0	0	0	3	0	0		
269	0	0	0	4	0	0		
272	0	0	0	0	0	0		
274	0	0	0	7	0	1		
276	0	0	0	4	0	64		
277	0	0	0	13	0	14		
279	10	2	16	3	0,42	6	24	9,51
280	2	1	33	17	0,08	18	25	1,59
281	5	1	16	12	0,45	6	21	7,02
282	26	0	0	0	0,66	5	32	16,67
283	1	0	0	6	0,04	4	25	1,75
285	3	0	0	3	0,18	0	17	6,81
287	3	0	0	0	0,06	0	50	2,62
294	8	0	0	2	0,16	11	50	4,41
297	2	0	0	0	0,07	0	29	2,18
317	0	0	0	24	0	0		
319	0	0	0	2	0	61		
324	0	0	0	3	0	0		
326	7	0	0	6	0,28	17	44	5,66
329	0	0	0	9	0	0		
331	15	0	0	11	0,64	0	19	20,53
336	2	0	0	0	0	0	20	4,06
340	0	0	0	2	0	0		
341	0	0	0	0	0	0		
342	0	0	0	2	0	0		
343	3	0	0	0	0,08	2	38	3,25
345	3	0	0	8	0,1	0	30	13,25
348	1	0	0	0	0,02	0	50	0,68
349	0	0	0	3	0	0		
351	0	0	0	0	0	0		
Average	5	1	4	8	0	9	33	8,67

Plantig date: February 25/2006

Table # 33. Pulp and cotyledon sensorial evaluations conducted during 2008 and 2009 in 216 hybrid trees selected in a group of hybrid families in the frame of CFC/ICCO/IPGRI and CFC/ICCO/Bioversity projects.

Nº	Family	Hybrid Tree	Trial	Pulp					Cotyledon				
				Sweet	Acidity	Astringency	Frutal	Floral	Bitter	Acidity	Astringency	Frutal	Floral
1	CCAT-21-19 x CCAT-46-68	T1-R1-A5	18 Híbridos	1	3	2	0,5	0,3	2,8	1,5	1,8	0,8	0,4
2	CCAT-21-19 x CCAT-46-68	T1-R1-A6	" "	2	2,5	4,5	2,5	0	4	2	5	1	0
3	CCAT-21-19 x CCAT-46-68	T1-R1-A3	" "	2	2	4	2	0	3,5	2	2	1	0
4	CCAT-21-19 x CCAT-46-68	T1-R1-A8	" "	2,8	1,1	0,8	0,5	1,8	3,4	2	2,1	0,4	0,3
5	CCAT-21-19 x CCAT-50-64	T2-R1-A1	" "	1	2	0	0	1	2,5	1,5	2	1	0
6	CCAT-21-19 x CCAT-50-64	T2-R2-A1	" "	1,5	1	1	0	1,5	2	1	2,5	0	0
7	CCAT-21-19 x CCAT-50-64	T2-R2-A2	" "	2	2,5	1,5	1	1	3,5	1,3	2	1	0
8	CCAT-21-19 x CCAT-50-64	T2-R3-A2	" "	1,6	0,8	1,5	0,1	0	2,4	0,9	2,8	0,5	0,1
9	CCAT-21-19 x CCAT-50-64	T2-R3-A4	" "	0,3	0,8	0,5	0,1	0	3	2,3	2,6	0,5	0
10	CCAT-21-19 x CCAT-50-64	T2-R2-A5	" "	1,7	1,7	1,1	0,7	1	2,6	0,8	1,8	0,1	0,4
11	CCAT-18-58 x CCAT-50-64	T3-R2-A6**	" "	1,5	2,5	5	0	3	3	2	2,8	1	3
12	CCAT-18-58 x CCAT-46-68	T5-R2-A5**	" "	2,5	2,25	0,75	3,25	0,5	1,5	0	1,25	0,4	0
13	EET-445 x EET-400	T7-R3-A2**	" "	1,7	1,9	1,2	1,7	1,7	1,9	0,8	1,4	0,5	1,4
14	EET-445 x EET-400	T7-R3-A3	" "	1,7	2,7	2	2,2	0,4	3,2	2	2,6	0,5	0,4
15	EET-445 x EET-400	T7-R3-A4	" "	1,6	2,1	2,3	0,3	0,5	2,8	1,9	2,2	0	0
16	EET-445 x EET-400	T7-R4-A5**	" "	4	0,5	1	1	2	1	0	1,5	1	1
17	EET-445 x EET-400	T7-R4-A2**	" "	2,5	0,5	1	1	2,5	2	1	1,5	0	2
18	EET-451 x EET-387	T8-R1-A3**	" "	2	3,8	1,3	2	1,5	1,7	1,3	1,3	0,7	0
19	EET-451 x EET-387	T8-R1-A4**	" "	2	1,9	0,5	2,4	1,8	3,3	2,3	2,5	0	0,4
20	EET-451 x EET-387	T8-R1-A10	" "	1,7	0,3	2,5	2	0,3	2,8	0,7	2,7	0,3	0,7
21	EET-451 x EET-387	T8-R2-A4	" "	2	0,7	2,5	1,7	0,7	3,2	1,3	3	0,3	1
22	EET-451 x EET-387	T8-R3-A9	" "	1,8	1,2	0,9	1,1	0,8	3,6	2	2,2	0,6	0,3
23	EET-451 x EET-387	T8-R3-A3	" "	1,6	1,6	0,3	1,1	1,3	4,2	1,9	2,9	0,3	0,7
24	EET-451 x EET-387	T8-R4-A2**	" "	1	1,5	3	2,5	1,5	1	0	1	0	0
25	EET-451 x EET-387	T8-R4-A4**	" "	4	0	0	2,5	0	1	0	1	2	0
26	EET-454 x CCAT-50-64	T9-R1-A8**	" "	1,8	2,3	0,8	2,3	2,3	2,5	1,8	1,5	0,3	0,8
27	EET-454 x CCAT-50-64	T9-R1-A9**	" "	2,5	1,8	2	2,3	0,3	1	0,5	1	1,5	1,3
28	EET-454 x CCAT-50-64	T9-R2-A8**	" "	2,3	0,7	0,7	1,9	1,3	0,9	0,9	1,1	0,9	1,7
29	EET-454 x CCAT-50-64	T9-R3-A3**	" "	2	1	0	1	2	0	1	1	0	1,5
30	EET-454 x CCAT-50-64	T9-R4-A8	" "	1,5	0,5	1	1	0	2	0,5	2	0	0

Coming from Table # 33.

31	EET-454 x CCAT-50-64	T9-R4-A10	" "	1,5	1	1	0	0	1,5	0	1	1	0
32	EET-446 x EET-400	T10-R2-A7**	" "	3,2	2,3	3,3	4	0	4,5	1,5	3,8	3	0,8
33	EET-446 x EET-400	T10-R3-A9**	" "	4	2	2,5	3,5	0	2	1	2	1	0
34	EET-446 x EET-400	T10-R4-A3**	" "	2,5	1	0	3	1,5	1	0	1	0	0
35	CCN-51 x CCAT-21-19	T11-R3-A6	" "	1	1	3	1,5	1	4	1	3,5	1	0
36	CCN-51 x CCAT-21-19	T11-R3-A7	" "	1	1,5	2,5	0	0	2	0,5	1,5	0	0
37	CCN-51 x CCAT-21-19	T11-R3-A9	" "	2,5	2	3	1	0	3	1	3,5	1	0
38	CCAT-49-98 x CCAT-46-68	T13-R2-A6**	" "	2	2,5	4	2,5	0	3	1,5	2	3,5	0
39	CCAT-49-98 x CCAT-46-68	T13-R2-A9**	" "	3	3	3,5	4	0	2,5	1	3	2,5	0
40	CCAT-46-68 x CCAT-49-98	T14-R2-A1**	" "	2	4	5	2,25	0	4,5	2	4,5	2	0
41	CCAT-46-68 x CCAT-49-98	T14-R4-A2	" "	0,7	0	1	0	0	1,7	0	1,3	0,3	0
42	EET-454 x EET-400	T15-R2-A5**	" "	2,8	0,4	1,0	0,8	1,5	2,5	2,0	1,6	0,9	0,7
43	EET-454 x EET-400	T15-R4-A4	" "	2	2	2,5	3	0	2,5	2	3	1	0
44	EET-454 x EET-400	T15-R4-A9**	" "	3,2	2,7	2,3	2,3	1,8	3,3	2,6	2,7	0,2	1
45	CCAT-49-98 x CCAT-50-64	T16-R4-A5	" "	2	1	2	1,5	0	2	0,5	1,5	1	0
46	CCAT-49-98 x CCAT-50-64	T16-R3-A3**	" "	3,5	1	2	2,5	0	3	1	2,5	1	0
47	CCAT-49-98 x CCAT-50-64	T16-R3-A5	" "	0,9	2,4	1,9	1,1	0,4	2,1	0,6	3,5	0,4	0,4
48	CCAT-46-68 x CCAT-50-64	T17-R1-A5	" "	1,5	3,3	2,8	1,5	0,8	2,5	1	1,3	0	1,8
49	CCAT-46-68 x CCAT-50-64	T17-R2-A6**	" "	1	3	4,5	2,5	0	4,5	2	3,5	1	0
50	CCAT-46-68 x CCAT-50-64	T17-R3-A1	" "	1	1,5	2,5	2	0	1	0	1	0,8	0
51	CCAT-46-68 x CCAT-50-64	T17-R4-A5	" "	1,5	2	3	1,5	0	3	1	2,5	1	0
52	CCAT-46-68 x CCAT-50-64	T17-R4-A4	" "	3	1,5	2	2	0	3	1,5	2	0	0
53	EET-454 x CCAT-21-19	T18-R4-A5	" "	3	1	0	1	0	2,5	0	3	1,5	0
54	EET-454 x CCAT-21-19	T18-R4-A4**	" "	4	0	0	2,5	0	1	0	1	2	0
55	EET-454 x CCAT-21-19	T18-R2-A8**	" "	3,7	1,7	0,8	2,3	1,7	2,7	2,3	4	0	0
56	EET-416 x EET-400	T1-R1-A5	21 Híbridos	1,7	1,3	0,3	0,7	1,5	3,2	1,0	3,8	0,3	0,3
57	EET-416 x EET-400	T1-R1-A6	" "	2,5	1,0	1,0	2,0	1,0	3,0	0,5	4,0	0,0	1,0
58	EET-416 x EET-400	T1-R1-A8	" "	2,0	0,5	0,5	1,5	0,0	2,5	1,0	3,5	1,0	0,0
59	EET-416 x EET-400	T1-R3-A3**	" "	3,5	2,2	2,8	3,2	2,2	3,0	1,0	2,8	1,0	0,7
60	EET-426 x CCN-51	T2-R2-A1**	" "	3,0	4,0	5,0	3,0	2,0	5,0	2,0	5,0	0,0	3,0

Coming from Table # 33

61	EET-426 x CCN-51	T2-R2-A7	" "	1,0	1,0	1,5	1,0	1,5	4,5	1,0	3,5	0,0	1,5
62	EET-426 x CCN-51	T2-R2-A9**	" "	3,8	0,8	2,0	2,0	4,5	4,5	1,8	4,3	2,3	1,3
63	EET-426 x CCN-51	T2-R4-A6**	" "	4,8	2,3	3,8	3,3	0,5	2,3	0,5	2,0	1,3	0,0
64	EET-426 x CCN-51	T2-R4-A5	" "	0,0	4,0	4,5	0,0	0,0	1,0	0,0	1,5	0,0	0,0
65	EET-426 x CCN-51	T2-R4-A1**	" "	3,0	4,0	5,0	3,0	2,0	5,0	2,0	5,0	0,0	3,0
66	EET-426 x CCN-51	T2-R4-A9**	" "	3,8	0,8	2,0	2,0	4,5	5,0	1,8	4,5	0,0	3,5
67	EET-426 x EET-574	T3-R2-A6**	" "	2,0	1,5	2,5	3,5	0,0	4,0	1,5	4,5	1,0	0,0
68	EET-426 x EET-233	T4-R1-A9	" "	4,0	2,0	1,0	1,5	2,0	3,0	0,0	1,5	1,0	0,0
69	EET-426 x EET-233	T4-R3-A6**	" "	3,5	3,0	2,0	4,0	1,0	4,0	1,5	3,0	1,0	0,0
70	EET-426 x EET-387	T5-R1-A6	" "	4,2	1,3	1,5	0,0	1,3	1,3	0,3	2,5	0,7	0,7
71	EET-426 x EET-387	T5-R2-A6	" "	4,0	1,0	0,0	1,5	0,0	3,0	1,0	2,5	0,8	0,0
72	EET-426 x EET-387	T5-R2-A5	" "	3,5	0,5	0,5	2,5	0,0	2,0	0,5	3,0	0,0	0,0
73	EET-446 x EET-387	T6-R1-A3	" "	3,7	1,3	1,0	2,3	2,2	2,7	1,3	2,0	1,7	1,0
74	EET-446 x EET-387	T6-R2-A1	" "	1,7	2,0	3,9	1,7	1,5	3,5	0,7	3,2	1,5	0,7
75	EET-446 x EET-387	T6-R3-A1	" "	2,0	3,2	3,5	0,3	2,2	2,7	1,7	1,7	0,0	0,3
76	EET-446 x EET-387	T6-R4-A4	" "	4,0	3,7	3,3	0,0	0,7	2,7	1,0	2,8	0,0	1,3
77	EET-445 x CCN-51	T7-R1-A2	" "	1,0	2,0	2,5	2,0	0,0	1,0	0,0	0,0	1,5	0,0
78	EET-445 x CCN-51	T7-R1-A3	" "	0,5	4,5	2,5	1,0	0,0	4,0	3,0	4,5	0,0	0,0
79	EET-445 x CCN-51	T7-R1-A7	" "	1,7	2,8	4,3	1,5	0,3	4,2	1,8	4,2	0,0	0,0
80	EET-445 x CCN-51	T7-R3-A3	" "	1,8	2,5	5,0	1,0	0,0	5,0	2,0	5,0	0,0	0,0
81	EET-445 x CCN-51	T7-R1-A5	" "	2,3	4,2	4,3	1,5	0,0	2,3	3,2	4,3	0,8	0,0
82	EET-445 x CCN-51	T7-R4-A5	" "	2,0	3,8	3,0	0,5	0,0	3,5	2,0	3,5	0,0	0,0
83	EET-445 x CCN-51	T7-R4-A2	" "	1,5	1,0	2,8	1,0	0,5	2,5	1,0	2,5	1,0	0,0
84	EET-445 x EET-578	T8-R2-A7**	" "	3,5	1,5	2,0	4,0	0,0	3,0	2,0	3,5	1,0	0,0
85	EET-445 x EET-578	T8-R4-A4	" "	2,0	1,0	4,0	1,0	0,0	3,0	1,8	2,6	0,5	0,0
86	EET-445 x EET-578	T8-R4-A2	" "	1,8	1,5	2,0	1,8	1,0	2,5	1,0	3,5	1,0	0,0
87	EET-446 x CCN-51	T9-R1-A1	" "	4,0	2,0	4,0	2,0	0,0	2,0	0,0	2,0	1,0	0,0
88	EET-446 x CCN-51	T9-R3-A2**	" "	2,5	1,0	3,8	3,0	0,0	1,8	0,0	2,0	0,5	0,0
89	EET-446 x CCN-51	T9-R3-A3	" "	2,8	4,0	4,2	2,2	0,0	4,5	1,7	3,5	0,0	0,0
90	EET-446 x CCN-51	T9-R3-A10	" "	1,5	2,0	2,0	0,0	2,0	2,0	0,0	1,0	0,0	1,0

Coming from Table # 33.

91	EET-446 x CCN-51	T9-R3-A5**	" "	2,2	3,5	4,2	2,5	0,0	4,8	2,3	4,7	1,2	0,5
92	EET-446 x CCN-51	T9-R3-A9	" "	1,7	0,3	0,0	0,8	0,0	3,5	2,0	3,2	1,0	0,3
93	EET-446 x CCN-51	T9-R4-A8	" "	2,0	0,0	0,0	0,0	0,0	4,0	1,8	3,8	1,0	0,0
94	EET-446 x CCN-51	T9-R4-A10	" "	1,5	1,0	0,0	1,0	0,0	3,5	2,3	2,0	0,0	0,0
95	EET-446 x EET-547	T10-R1-A10	" "	3,5	1,7	2,0	2,3	1,3	3,0	1,3	3,7	1,7	1,0
96	EET-446 x EET-547	T10-R2-A3	" "	3,7	0,3	0,0	1,8	0,3	0,3	0,3	0,0	0,0	0,5
97	EET-446 x EET-547	T10-R2-A7	" "	2,5	0,0	0,5	1,0	0,0	0,0	1,0	0,0	0,0	0,0
98	EET-446 x EET-547	T10-R3-A9	" "	1,5	1,0	2,0	2,0	0,5	1,0	0,5	0,0	0,0	0,0
99	EET-446 x EET-547	T10-R4-A3**	" "	1,0	1,5	2,5	1,5	1,0	0,8	1,0	0,0	0,0	0,0
100	EET-451 x EET-574	T11-R3-A6	" "	2,5	2,0	1,5	0,5	0,0	1,0	1,0	1,5	2,0	0,5
101	EET-451 x EET-574	T11-R3-A7	" "	2,0	1,5	2,0	1,0	1,5	2,8	0,5	1,0	1,0	0,0
102	EET-451 x EET-574	T11-R3-A9**	" "	3,0	1,0	2,5	4,0	1,0	3,0	1,0	0,0	1,5	0,5
103	EET-451 x EET-578	T12-R2-A8	" "	2,0	1,0	1,5	1,0	0,0	3,0	2,0	3,5	1,0	0,0
104	EET-452 x CCN-51	T13-R2-A6**	" "	1,8	4,0	3,5	3,5	0,0	4,0	1,0	4,5	1,0	0,0
105	EET-452 x CCN-51	T13-R4-A3**	" "	2,5	3,5	5,0	5,0	0,0	5,0	2,0	5,0	2,0	3,0
106	EET-454 x EET-577	T14-R2-A7	" "	4,5	2,8	4,0	1,5	2,5	4,0	1,0	3,3	0,5	0,0
107	EET-454 x CCN-51	T15-R4-A6	" "	1,0	0,0	0,0	0,0	0,0	2,0	1,0	1,0	0,0	0,0
108	EET-454 x EET-387	T16-R4-A5	" "	1,0	2,8	3,0	1,5	0,5	4,0	0,0	3,5	1,5	1,0
109	EET-454 x EET-387	T16-R3-A3	" "	2,5	1,5	2,8	2,0	1,5	3,0	1,0	2,8	1,0	0,0
110	EET-454 x EET-574	T17-R1-A2**	" "	5,0	2,5	2,0	2,8	0,0	3,0	0,3	1,8	1,0	0,0
111	EET-454 x EET-574	T17-R1-A8**	" "	5,0	3,0	1,0	3,5	0,0	3,0	0,5	1,0	1,0	0,0
112	CCN-51 SEMILLA (T2)	T21-R4-A3**	" "	3,0	3,0	4,0	2,0	0,0	3,0	1,8	2,5	2,0	0,0
113	EET-574xEET-547	T1-R2-A1	Ensayo 1 2.1	2	1	2	0	0	3	1	2,5	0	0
114	EET-574xEET-547	T1-R2-A7	" "	2,5	0,8	2,2	0	0	2,8	1,5	2,2	0	0
115	EET-574xEET-547	T1-R4-A3	" "	2,4	1,2	2	0	1	2	0,8	2	0	0
116	EET-574xEET-547	T1-R4-A10	" "	2,5	0	2,1	0	0	2,5	1	2,2	0	0
117	EET-574xEET-547	T1-R4-A7	" "	2,2	1	2	0	0	3	1	2,5	0	0
118	EET-577xEET-547	T2-R1-A3	" "	3,5	1	2	0	1	4	1	3,5	0	0
119	EET-577xEET-547	T2-R2-A8	" "	3	1,5	2,8	1	0	4,5	1,5	3,2	1	0
120	EET-577xEET-547	T2-R2-A9	" "	3,2	1,2	2,5	1,5	0,5	3,8	1	3	0	0

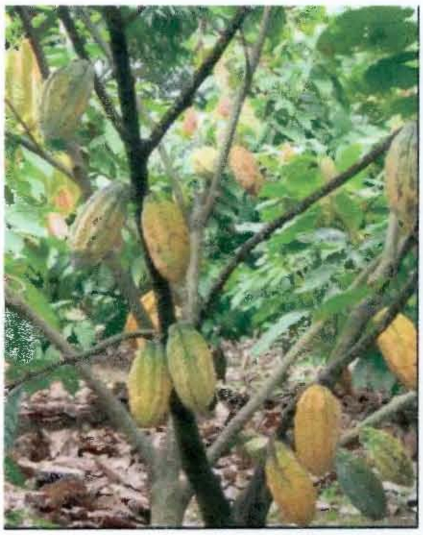
Coming from Table # 33

121	EET-577xEET-547	T2-R3-A10	" "	3,2	1,5	3	0	0	3,5	1	3	0,5	0
122	EET-384xEET-547	T3-R1-A7	" "	2,5	1,8	2	1,5	1	4	2	3,5	0	0
123	EET-552xEET-547	T4-R1-A9	" "	3	1	0	2	0	3	2	1	0	0
124	EET-552xEET-547	T4-R1-A6	" "	3	2,2	0	1,5	0	3,2	1,5	1	0	0
125	EET-552xEET-547	T4-R1-A4	" "	2,5	3	3	0	0	3	2	1,5	0	0
126	EET-574xEET-534	T5-R1-A8	" "	3	1,5	1	2	0	2,5	1,5	1,5	0	0,5
127	EET-574xEET-534	T5-R1-A10	" "	2,5	1	1	0	0	2,5	1	1	0	0
128	EET-574xEET-534	T5-R1-A9	" "	2	0	0	1,5	0	3	1,5	1	0	0
129	EET-574xEET-534	T5-R2-A6	" "	2,4	0	0	1,8	0	3,5	1	1	0	0
130	EET-574xEET-534	T5-R2-A1	" "	2	1	0	1	0	3,2	1,4	1	0	0
131	EET-577xEET-534	T6-R1-A8	" "	1,5	2	2,5	2	0	1,5	3	0,5	0	1
132	EET-577xEET-534	T6-R1-A9**	" "	1,5	1	1,5	1,5	0	1,5	3	0,5	0	1,5
133	EET-577xEET-534	T6-R1-A10**	" "	2,5	1	1	1	0	2,5	1,5	0,5	0	1,5
134	EET-552xEET-534	T7-R1-A10	" "	4	2	3,5	1	1,5	2,8	1	3	0	1
135	EET-552xEET-534	T7-R1-A3	" "	4,5	2,5	3	1	0,5	2,5	1	2	1	0
136	EET-552xEET-534	T7-R1-A-10	" "	3,5	2	2,5	1,5	1	2,4	1,2	2	0	1
137	EET-574xEET-513	T8-R1-A10	" "	3	2,5	2,5	0	0	3,5	2	1,5	0	0,5
138	EET-574xEET-513	T9-R1-A1	" "	2	1,5	1	1	0	2,5	2	0	0	0
139	EET-577xEET-513	T9-R1-A-8	" "	2,5	1	1	0	0	3	3,5	1	0	0
140	EET-552xEET-513	T10-R1-A9	" "	3	2	2,8	2	0	2	1	3,5	1	0
141	EET-19xEET-48	T11-R1-A 9	" "	3	1	1	0	1	0,5	1	1	0	0
142	EET-48xEET-95	T12-R1-A2	" "	2,5	1	2	0	1	1	1	2	0	1
143	EET-48xEET-95	T12-R2-A7	" "	2	1,5	2,2	0	1,5	1,5	1	1,5	0	0
144	EET-48xEET-95	T12-R2-A9	" "	2,8	1,8	2,5	1	1	1,8	1	1	0	1
145	EET-48xEET-95	T12-R3-A3	" "	2,5	1,5	2,2	0,5	0,8	1,5	1	1,2	0	1
146	EET-62xEET-103	T13-R1-A9**	" "	2	2,8	3	0	1,8	3	1	1	0	1,5
147	EET-62xEET-103	T13-R1-A1**	" "	2,5	3	3,5	0	2	2,5	1	1	0	1
148	EET-62xEET-103	T13-R1-A2**	" "	3	2,5	3	0	2,5	2,5	1,5	1	0	1,2
149	EET-62xEET-103	T13-R1-A4	" "	4	2	2,5	0	3	2,5	2	1,5	0	0,5
150	EET-62xEET-103	T13-R2-A3**	" "	3	2	2	0	2,8	2,2	1	1	0	1,2
151	EET-62xEET-103	T13-R3-A6**	" "	3,5	2,2	2,5	0	3,2	2	1,2	1,2	0	1,5
152	EET-62xEET-103	T13-R4-A10**	" "	3,2	2,5	2	0	3,5	2,2	1,5	1,5	0	2
153	EET-62xEET-103	T13-R5-A4**	" "	3	2,5	2,2	0	2	2	1,4	1,2	0	2,5
154	EET-62xEET-103	T13-R5-A1**	" "	4	2	2	0	2,5	1,8	1,5	1,5	0	2,2
155	EET-574xEET-577	T15-R1-A4	" "	2	1	2	0	1	2	1	2,5	0	1

Coming from Table # 33.

156	EET-574xEET-577	T15-R1-A5	" "	2,5	1,5	1,8	0	0,5	2,5	0,5	2,8	0	0,5
157	EET-574xEET-577	T15-R1-A6	" "	2,2	1	2	0	1	2	0,8	3	0	0,8
158	CCN-51 Autopolinización.	T16-R1-A1	" "	3	1	0,5	0	0	4	1	4	0	0
159	CCN-51 Autopolinización.	T16-R1-A7	" "	3,5	2,5	1,5	1	0	4	0,5	4,5	0	0
160	CCN-51 Autopolinización.	T16-R1-A9	" "	4,5	2,5	2	2	0	4	2	3,8	0	0
161	CCN-51 Autopolinización.	T16-R1-A8	" "	4	2,5	2,5	1,5	0	4,5	1,5	4	0	0
162	CCN-51 Autopolinización.	T16-R2-A10	" "	4,5	3	2	2	0	4	1	4,5	0	0
163	EET-416 x EET-233	T1-R1-A1	Ensayo 1.2.2	3,0	2,3	2,0	1,5	0,0	3,3	2,3	1,5	0,0	1,3
164	EET-416 x EET-233	T1-R1-A9	" "	4,3	0,5	0,0	2,0	0,0	3,8	3,0	1,5	0,0	0,5
165	EET-416 x EET-233	T1-R1-A10	" "	4,0	1,5	0,0	1,0	0,0	2,0	3,0	2,0	0,0	1,0
166	EET-462 x EET-233	T2-R1-A1	" "	1,8	0,5	1,0	0,5	0,0	1,8	1,0	1,3	0,0	0,5
167	EET-462 x EET-233	T2-R1-A7	" "	4,3	2,8	3,0	0,0	0,0	1,5	3,0	2,3	0,0	0,0
168	EET-462 x EET-233	T2-R1-A 8	" "	3,0	1,8	1,0	0,0	0,0	3,3	1,8	1,8	0,0	1,3
169	EET-452 x EET-233	T3-R1-A1	" "	1,8	1,3	1,0	1,0	0,0	2,0	1,0	0,0	0,0	0,7
170	EET-452 x EET-233	T3-R1-A3	" "	2,3	1,8	2,3	0,8	0,0	1,7	1,0	0,0	0,0	0,0
171	EET-452 x EET-233	T3-R1-A4	" "	2,7	1,2	1,0	0,7	0,0	3,0	2,3	1,7	0,0	1,0
172	CCN-51 x EET-233	T4- R1-A2	" "	3,0	1,0	0,0	1,0	0,0	3,0	2,5	1,5	0,0	0,0
173	CCN-51 x EET-233	T4- R1-A3	" "	3,1	1,1	0,0	1,2	0,0	3,5	2,5	1,2	0,0	0,0
174	CCN-51 x EET-233	T4- R1-A8	" "	2,8	1,5	0,0	1,4	0,0	3,4	2,5	1,4	0,0	0,0
175	CCN-51 x EET-233	T4- R1-A9	" "	3,2	1,3	0,0	1,5	0,0	3,3	2,8	1,3	0,0	0,0
176	CCN-51 x EET-233	T4-R1-A10	" "	3,5	2,2	1,8	0,8	0,0	3,0	2,3	1,7	0,0	0,5
177	CCN-51 x EET-233	T4-R1-A4	" "	2,8	2,8	3,2	0,0	0,0	2,8	2,0	1,5	0,0	0,0
178	EET-416 x EET-387	T5-R1-A10	" "	2,5	1,0	1,0	0,0	0,0	2,5	1,0	1,0	0,0	0,0
179	EET-416 x EET-387	T5-R1-A9	" "	2,0	0,0	0,0	1,5	0,0	3,0	1,5	1,0	0,0	0,0
180	EET-416 x EET-387	T5-R1-A7	" "	3,5	1,5	1,0	1,5	0,0	2,0	1,0	1,0	0,0	0,5
181	EET-416 x EET-387	T5-R1-A8	" "	3,0	1,5	1,0	2,0	0,0	2,5	1,5	1,5	0,0	0,5
182	EET-450 x EET-387	T6-R1-A8	" "	1,5	2,0	2,5	2,0	0,0	1,5	3,0	0,5	0,0	1,0
183	EET-450 x EET-387	T6-R1-A9**	" "	1,5	1,0	1,5	1,5	0,0	1,5	3,0	0,5	0,0	1,5
184	EET-450 x EET-387	T6-R1-A10**	" "	2,5	1,0	1,0	1,0	0,0	2,5	1,5	0,5	0,0	1,5
185	EET-462 x EET-387	T7-R1-A1**	" "	2,8	1,5	1,0	0,0	0,0	4,0	4,0	1,8	0,0	1,5
186	CCN-51 x EET-387	T8-R1-A1	" "	4,0	2,0	3,0	0,0	0,0	4,5	2,0	1,5	0,0	0,0
187	CCN-51 x EET-387	T8-R1-A2	" "	3,0	2,5	2,0	1,0	0,0	2,5	1,5	1,0	0,0	0,5
188	CCN-51 x EET-387	T8-R1-A10	" "	3,0	2,5	2,5	0,0	0,0	3,5	2,0	1,5	0,0	0,5
189	CCN-51 x EET-387	T8-R1-A3**	" "	4,0	1,0	0,5	2,0	0,0	2,0	1,0	0,5	0,0	1,5
190	EET-416 x EET-534	T9-R1-A1	" "	1,2	1,5	1,5	1,0	0,0	3,0	2,5	1,0	0,0	0,0

Set of photographs of some selections made up during the project CFC/ICCO/Bioversity International.



Set of photographs of some selections made up during the project CFC/ICCO/Bioversity International.

Set of photographs of some selections made up during the project CFC/ICCO/Bioversity International.