CONILON
Coffee

3rd Edition
Updated and expanded




The Coffea canephora produced in Brazil

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Generation, Diffusion and Transfer of Technology for Conilon Coffee in the State of Espírito Santo

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1 INTRODUCTION

It has been more than four decades since conilon coffee is the protagonist of a history of struggles and achievements, of a trajectory marked by stigmas and successes, moving from a supporting position to occupy a prominent place in the national and Espírito Santo economy.

The current performance of this product production chain is especially linked to several factors: the saga of the activity pioneers, the rural leaders entrepreneurship, the experimental producers performance, the set of knowledge, technologies and innovations generated by the researches, the interaction of the existing institutional arrangement, the public and private technical assistance and rural extension supporting services with their differentiated approach methodologies, the unconditional support of the industrial segment, the press and, above all, the profile and vocation of farmers in the State of Espírito Santo. It was based on this observation that the following work was conceived and organized.

The chapter is structured in three basic pillars: the first seeks to search the history and the trajectory told and recorded by the great events, chronologically, without losing sight of this report tonic, which is to highlight the main generation, diffusion and technologies transference actions. This description, therefore, does not have the purpose of exhausting the subject with the facts occurred nor the intention to tell the conilon coffee history since its introduction in the south of the State, in Cachoeiro de Itapemirim. In fact, its main function is to facilitate the understanding of the generation, diffusion and technology transfer process from the moment in which the conilon coffee cultivation became considered an economic option and, in this way, prepare the reader for the central theme of this work.

The second deals with the technological base, infers about some conceptual elements and presents the main technologies, knowledge and innovations available that are responsible for the vanguard and hegemony of the State in this type of coffee.

It is not about a technological inventory, which would certainly demand the exhaustion of

the subject, but a list of technologies with their respective description, enough to demonstrate the technological stage of the activity. Also in this regard, some considerations were made on clonal gardens and seedlings nurseries as a strategy for the technologies diffusion and transfer for the development, renewal and enhancement of conilon coffee farming in Espírito Santo.

In the methodological basis, third pillar considered, the focus is on the main methodologies used by the institutions that offer services to the activity both from the point of view of technical assistance and rural extension. It is true that the difficulty of recording and making available data on the performance of these two services impaired a little the analyzes, but it was possible to present and deduce about it, based, mostly, on the performance of the official service and other entities that made available their reports.

From the perspective presented, always from the point of view of technology generation, diffusion and transfer for this culture, some final considerations were elaborated that can help in future reflections to advance even further with this activity so important for the state society.

2 HISTORY, TRAJECTORY AND GREAT DEVELOPMENTS

2.1 HISTORY

The history of the generation, diffusion and technology transfer for conilon coffee originated in the year 1970, when the Municipality of São Gabriel da Palha, encouraged by its Mayor, Mr. Eduardo Glazar, decided to produce and distribute free conilon coffee seedlings to the farmers of that municipality, under the technical guidance, at that time, of the agricultural engineering Ailton Vargas de Souza and the agricultural technician Elias dos Anjos, both employees of the Associação de Crédito e Assistência Rural do Espírito Santo- Acares (Association of Credit and Rural Assistance of Espírito Santo).

This attitude represented the effort and the struggle to create alternatives for farmers, in view of the Federal Coffee Eradication Program, which decimated the culture in the state of Espírito Santo from 1963 to 1966,when the municipality was not contemplated with the Renovation Plan of the Coffee Area, launched in 1969, by the Federal Government, that brought in its scope the coffee plantations financing only in regions with altitude superior to 400 meters.

The earlier decision to produce and distribute seedlings by municipal government was strengthened by the successor mayor Mr. Dario Martinelli, who, in alternating mandates processes, conceived, executed and, thus, created the embryo of the fostering seedlings policy, with technology transfer to conilon coffee. The Conilon Project, so-called at the time, conditioned that the beneficiary of the free seedlings should necessarily adopt the level planting technology, recommended by the Instituto Brasileiro do Café- IBC.(Brazilian Coffee Institute).

In fact, the efforts of these two leading precursors of the State's conilon coffee (1967 to 1982) sum up, in fifteen years, the fight against the effects of coffee eradication, the creation of income alternatives with the conilon incentive and planting, the effort to include this coffee

type in the financing policy for the activity and, more importantly, the market search for the product.

It was observed in all this movement that, in 1972, the agricultural engineering Eumail of Medeiros Bastos and Wanderlino de Medeiros Bastos installed a nursery for the production of conilon seedlings produced by seed, with capacity for 300 thousand plants. This venture was the creation cell of Verdebras, which later became a pioneer in the commercial scale production of clonal seedlings of this crop.

The incentives of the São Gabriel da Palha municipal government and the consequent increase in the seedlings supply have led to the plantations expansion, including in other municipalities of the State, already incorporating, in its almost totality, the system of contour lines and many other recommended technologies for the arabica plantations, since for the conilon coffee there were practically no developed researches.

With established plantings and production beginning to appear in the statistics in 1974, registering 200 thousand bags produced (GLAZAR, 2005), it was necessary to create market guarantees for the product. In this regard, the advent of the implantation of the Real Café Solúvel in 1971, gave the necessary support to continue the plantations expansion, especially in the north of the State. The chairman of the company mentioned, Mr. Jônice Tristão, guaranteed, at that time, the acquisition of the conilon produced in the State of Espírito Santo.

Result of articulations and even of political state pressures in the middle of the 1970's, the Federal Government incorporated in the Renewal Program of Coffee Crops the financing for the conilon coffee cultivation. At that time, with the sharing of public actions, still dominant in the State's administrative organization, the policies of research, technical assistance and marketing for coffee were the exclusive competence of the IBC.

The conilon coffee inclusion in the programmatic actions of that organ, the resources abundance for subsidized interest financing and the evident interest of the producers in the crops expansion, aggravated by the problem of rust (*Hemileia vastatrix*) in arabica plantations, allowed a significant conilon expansion for several municipalities in the northern region of Espírito Santo, from the second half of the 1970s.

In the 1980s, it was the turn of other low altitude regions in the State to expand their plantations with increasing intensity, since municipal public power and the state incorporated into their guidelines the support for conilon coffee growers.

Therefore, the resistance of the Federal Government or the characteristic silence of their omission, social mobilization, especially leaders from the municipality of São Gabriel da Palha and the political sensitivity of the State authorities incorporated conilon coffee in the Capixaba rural development agenda (LOSS, 2004).

2.2 GENERATION AND TECHNOLOGIES TRANSFER TIME LINE

The generation of information, knowledge and technologies for conilon coffee in the State has as main reference frame the vegetative propagation technique initiated in 1972, when technicians of the extinct IBC were able to root parts of the plant as whole node and half node

cuttings, giving rise to seedlings with normal characteristics.

From this work, approximately 200 holes were planted in the Experimental Farm of Marilândia, located in the municipality of Marilândia/ES, concluding, after 22 years from planting, that the longevity of clonal plants is identical to those produced through seeds (PAULINO; PAULINI; BRAGANÇA, 1994).

In spite of the dominance of this technique is already more than 40 years, it was only used in large or commercial scale in 1983, having as reference the eucalyptus clonal multiplication process, adapted for conilon coffee.

With this technological innovation success, two important fronts of research and development were glimpsed in the State of Espírito Santo. The first motivated the IBC to continue in 1984 a series of studies and researches on the genetic capacity of rooting between conilon plants, types of substrates, packaging, hormones use for rooting, physiological age of the cuttings, rooting times, nursery types, fertilizers, pruning of parent plants and others. The main results of this work were published in the XII Brazilian Congress of Coffee Research, held in 1985.

The second important research and development front for the advancement of conilon coffee cultivation had its origin in private initiative. Also in 1983, and coincidentally, having as reference the same work developed with Eucalyptus by Aracruz Florestal at the time, the entrepreneurs of the present Verdebras adopted the technique and inserted the innovation in their production process of conilon coffee seedlings, this time, made in commercial scale. For that, they proceeded to the research and selection of parent plants that generated a genetic base of 25 clones that make up the two clonal varieties, the "G-30" and the "G-35" (VERDEBRAS, [198-?]). However, in the Ministério da Agricultura, Pecuária e Abastecimento - Mapa (Ministry of Agriculture, Livestock and Supply), only one is registered, called "G-30/G-35".

Since the creation of the Coffee State Coordination, in 1983, at the Secretaria da Agricultura, Abastecimento, Aquicultura e Pesca - Seag (Department of Agriculture, Supply, Aquaculture and Fisheries), it happened the articulations genesis, the formulation of new interventions and the follow-up of the actions that were already designed for this product, having as first coordinator the agricultural engineer Frederico de Almeida Daher.

But the official developmental framework for Research, Technical Assistance and Rural Extension for the conilon coffee of the State only occurred in 1985, when state companies began to contemplate that culture in their programs. On the one hand, the Empresa de Assistência Técnica e Extensão Rural - Emater-ES (Company of Technical Assistance and Rural Extension) included in its programming a set of actions aimed at the transfer of technologies to conilon coffee growers. On the other hand, the Empresa Capixaba de Pesquisa Agropecuária-Emcapa (Capixaba Company for Agricultural Research) began to develop a research program that initially contemplated the areas of genetic breeding, nutrition and plant physiology, with the purpose of offering coffee growers appropriate technologies for this crop, of which little was knew, except for the initial efforts of the IBC and the pioneer producers themselves.

It is recorded that the first state research project was installed in 1985 by the Emcapa researchers Carlos Henrique Siqueira Carvalho and Scheilla Marina Bragança, in the property of

Mr. João Colombi and was financed by the Cooperativa Agrária dos Cafeicultores de São Gabriel da Palha - Cooabriel (Agrarian Cooperative of the Coffee Growers of São Gabriel da Palha).

The State did not have its own seedlings multiplication program to meet the producers demand. Seag decided to purchase from 1 to 1.5 million clonal seedlings per year to make them available to producers. The private nursery, the largest supplier at that time, was Verdebras. The demand for quality seedlings from the genetic breeding process was 25 million per year, and the installed production capacity was around 8 million per year, which made it clear that there was a huge gap in the State's development policy.

This observation led Seag in 1991 to change the development policy, adopting the initiative to distribute seedlings to municipal governments, cooperatives and producer associations, among others, to form clonal gardens, supporting these institutions in the structuring of seedling nurseries, providing shade cloth and irrigation systems, as well as implementing a broad training program in the management of clonal gardens and seedling production. These actions were fundamental to make a quantitative and qualitative leap in the clonal seedlings supply.

With conilon coffee definitively included in the planning and implementation of public policies in the state agriculture portfolio, the programs were expanded with the support of financial resources from the Empresa Brasileira de Pesquisa Agropecuária - Embrapa (Brazilian Agricultural Research Corporation), whose results began to change the technological standard through the generation and transfer of information, knowledge and technologies, marked by the launch, in 1993, of the first three clonal varieties 'Emcapa 8111', 'Emcapa 8121' and 'Emcapa 8131' (BRAGANÇA et al., 1993, 2001), corroborated by various private sector actions in the areas of seedling development, commercial fertilizer companies and irrigation equipment.

The expansion of the technological base and the advancement of conilon coffee production led the State to organize technical and institutional actions and activities, launching in October 1993 the Programa de Revitalização da Cafeicultura Capixaba - Recafé (Capixaba coffee cultivation Revitalization Program). The purpose of this Program was to order research and technology transfer services, to create a financing line and to invest in these services facilities, in order to achieve goals projected for10 years in partnership with several entities in the production chain.

Five important events stood out in a very short period of time:

The first one refers to the creation, in 1993, of the Sector Coffee Chamber, which brings together the sector's main representations to elaborate and discuss policies and directions for coffee activity.

The second was the creation, in 1994, of the Centro de Desenvolvimento Tecnológico do Café- Cetcaf (Center for the Coffee Technological Development), established to be the organizer and facilitator between the public and private sectors.

The third concerns the holding of the First State Symposium on Coffee, created to be one of the main forums for discussion and debates of topics of interest to the activity. This event is coordinated by Cetcaf, with the participation of several entities in the coffee segment.

The fourth is related to the launch of the Technical Manual for the coffee cultivation in

the State of Espírito Santo, coordinated by Seg, which brought together the main available technologies, providing a fundamental technical leveling to the coffee cultivation advances.

The latter refers to the broad Conilon Coffee Pruning Campaign, which required a joint effort between the research and extension institutions, resulting in a high level of technology adoption, with significant consequences, above all, in the productivity increase and crops invigoration. Research results obtained by the Instituto Capixaba de Pesquisa, Assistência Técnica e Extensão Rural - Incaper (Capixaba Institute for Research, Technical Assistance and Rural Extension) point out, among the different advantages of pruning, the increase of up to 53.5% in productivity (SILVEIRA et al., 1993).

In 1996, the Mapa together with the Ministério da Indústria, do Comércio e do Turismo - MICT (Ministry of Industry, Commerce and Tourism) established the Programa Nacional de Pesquisa e Desenvolvimento do Café - PNP&D/Café (National Coffee Research and Development Program), whose objective was to develop joint work between the various institutions involved in Research and Development (R&D) and technology transfer for Brazilian coffee agribusiness (EMBRAPA CAFÉ, 2004).

Following this decision, the Consórcio Brasileiro de Pesquisa e Desenvolvimento do Café - CBP&D/Café (Brazilian Coffee Research and Development Consortium) was created in 1997, on the initiative of ten traditional Brazilian coffee research institutions including Incaper, which has provided important financial resources for the research projects development and technology transfer.

While research and technology transfer actions were increasingly emphasized in the State, Seag, together with Cetcaf and with Emater-ES, Emcapa and Mapa/Procafé participation, elaborated in 1997 the Agroecological Zoning for the coffee cultivation, defining in detail the spatial location of the different aptitude categories to guide the conilon crops implantation in the State of Espírito Santo (DADALTO; BARBOSA, 1997).

The State of Espírito Santo was going through a rich moment of generation of agricultural research results in several areas of knowledge and, consequently, the development of rural extension methodologies. The technology or knowledge generated was immediately available in various technical publications forms, which, after being used, were methodologically used in the technology transfer process by the state extension system.

In this particular case, the work carried out by Emater-ES, whose main focus was the development of extension methodologies to facilitate the technology transfer should be recorded. The company intensified this action in partnership with local entities motivated by the favorable environment of technologies availability generated for conilon coffee.

Many important extension methods were developed, however, due to its execution importance and complexity, it is justified to refer to the Conilon Coffee Productivity Contest of Aracruz, carried out from 1988 to 2000, which, even at municipal level, influenced and reverberated positively not only in the region but also throughout the State.

In the continuity of the research work on genetic breeding, Incaper, already having the research services, technical assistance and rural extension incorporated in the same institution, launched, in 1999, the 'Emcapa 8141 - Robustão Capixaba' clonal variety whose

main characteristic is related to drought tolerance, allowing coffee growers who do not have irrigation to obtain higher productivity in their crops (FERRÃO et al., 2000a).

Likewise, the strengthening strategy and expansion of clonal gardens focused on entities and nurseries was the key to this new technology diffusion action and transfer.

As the State implemented a renewal on its crops based on the use of superior and drought tolerant varieties, a number of research results in the fields of plant physiology, nutrition, crop management, soil conservation and irrigation technologies were made available and incorporated into the production system providing increasing gains in productivity and quality of the product obtained.

Facing a favorable climate of technological progress for conilon coffee, the State of Espírito Santo needed not only to give more visibility to this work, but also to discuss marketing issues and position itself on federal public policies for the sector. With this purpose, Cooabriel, strongly supported by Sicoob and the São Gabriel da Palha Municipal Government, in partnership with the State Government and other entities related to the sector, held in 1999 the Brazil Conilon Coffee Symposium, which completed six editions until 2009. This event was an important forum of presentations and debates on topics of interest to the conilon coffee in the country. Through it, the State of Espírito Santo was projected as the main quality conilon producer in national and international scope.

Despite the increase in productivity, it was observed that it was also necessary to work on quality issues. At that time, it was verified that the coffee borer represented 50% of the product defects in the trading, depreciating its value by the type aspect and the beverage (FONSECA; SILVEIRA; BRAGANÇA, 1999).

Based on this diagnosis, the State Government launched and implemented, through its related institutions and a set of partner institutions, a broad Coffee Borer Management Campaign, implementing a strong program to monitor and control this pest throughout the State during three consecutive years, from 2000 to 2002, reaching highly impacting results for the state coffee cultivation.

The coffee borer management campaign involved 161 vignette inserts on television, 1.584 spot insertions for the countryside radios, 150 spontaneous newspapers, radio and television, production and distribution of 7 thousand of 16 poster types, 54 courses for coffee growers, 47 lectures, 880 technical visits with monitoring of coffee growers' properties and several other events for the technology diffusion and transfer, with the involvement of 10,880 participants.

In order to prioritize regions with deficits of seedlings offers of the clonal varieties hitherto recommended and to serve those coffee growers who used their own genetic materials as matrices, Incaper launched the improved variety of seed propagation conilon, 'Emcaper 8151-Tropical Robusta' which can reach, on average, 50 and up to 80 bags/ha, with the use of other technologies including irrigation (FERRÃO et al., 2000b).

The technology transfer strategy of this variety, since its launch in March 2000, is based on the seed demands of Incaper's Escritórios Locais de Desenvolvimento Rural - ELDRs (Local Rural Development Office), representative institutions of rural producers and the direct demands of the coffee growers themselves.

The work developed with conilon coffee in Espírito Santo and the technological advances achieved, result of an adequate policy of technologies generation, diffusion and transfer, besides the institutional arrangement that was consolidated around these works, have made the State settle a prominent position in the national scenario.

Accredited and recognized by the Brazilian Consortium for Coffee Research and Development, the State of Espírito Santo was chosen to host, in September 2001, in Vitória, the Second Research Symposium Brazilian Coffees, whose success was evident with the involvement of 827 participants and with the presentation of 396 new research works, directed to all sectors of the national coffee industry (EMBRAPA CAFÉ, 2004). This event is held every two years and is the most important forum for discussion on the science and technology role in the coffee production chain.

In order to stimulate the local coffee cultivation and in the wake of the great episodes that took place in the State, municipal events proliferated, especially in 2001 and 2002. During this period, the schedules of the entities connected to the activity were full of not only salon events, but also included extension methodologies such as field days, courses, methods and results demonstration, producers excursions and productivity contest, which certainly have helped to disseminate main technologies that are changing the coffee cultivation technical base.

Having overcome all the planned goals in the Recafé Program, the Plano Estratégico de Desenvolvimento da Agricultura Capixaba - Pedeag (Strategic Plan for the Development of Capixaba Agriculture) was created in 2003, the result of numerous discussions with the state of Espírito Santo rural society, which allowed the reassessment of the main policies for coffee cultivation in the State. With it, an improvisations cycle for several productive chains, including coffee, was broken, which had its strategic actions and goals renewed for a ten year horizon (PEDEAG, 2003).

In the continuity of the technology transfer effort and in an innovative attitude, Cooabriel has developed a motivation program for the conilon coffee quality for its members. This is the Cooabriel Excellence Conilon Competition, started in 2003, which rewards producers with the production that has the best physical and sensory characteristics.

Incaper's continuous and incessant research, as a result of a strategic programming in the genetic breeding field, culminated in May 2004 with the launch of the clone variety 'Vitória Incaper 8142', which resulted from the clones selection, evaluation and characterization carried out during 18 years of research (FONSECA et al., 2005a). Its launching and dissemination to the Capixaba coffee growers gathered around 2.500 producers at Incaper Experimental Farm in Sooretama. In that occasion, it was made available about 2,000 seedlings of the kits variety to producers who were previously registered by the Incaper's ELDRs, with representation from all municipalities of the producing region. Simultaneously with this work, a plan was created to reinforce and expand existing clonal gardens and implement new ones to enable faster access to this important technology.

Together with the distribution of the genetic material components of the variety, a technical publications *kit* was distributed that includes specific information on the variety in question, production techniques with improved varieties and for the clonal gardens formation

and conduction.

With a well-coordinated strategy of technology diffusion and transfer, this variety contributed to the achievement of even more relevant results in the coffee plantations renewal with positive impacts on productivity and state production quality.

As the agenda of the main events and technology transfer actions for the conilon pointed to the north of the State, Cetcaf and the State Government, through Incaper, organized and held in September 2004, with the entities of the sector support, the South Capixaba Symposium of Conilon Coffee, in Cachoeiro de Itapemirim. This event, which is held periodically, has become strategic in the work of transforming the technological profile of coffee cultivation in the south of the State.

Also with the purpose of equalizing and harmonizing the conilon coffee farming development throughout the north of the state, Incaper, in partnership with Banco do Nordeste do Brasil - BNB (Northeast Bank of Brazil) and with the support of the Barra de São Francisco Municipal Government, in April 2005, the Northwest Conilon Coffee. The event counted on the participation of about 800 coffee growers previously registered in the entire northwest region of the state, granting them the access to seedlings of the Conilon Vitória clonal variety (Figure 1).

The *performance* of the research results production and the strategy for technologies promotion, diffusion and transfer achieved in recent years, especially since 1985, is known and recognized not only by the State coffee producers but also by important state, national and international entities and representations (Figure 2A).

Figure 1. Northwest Conilon Coffee Event, Barra de São Francisco/ES, in 2005.

As if it were not enough the scientific exchanges that it maintains as a science and technology institution, with several entities of the area, Incaper celebrated in 2005, an international technical cooperation agreement with Nestlé (France), aiming, in the foreground, to obtain information that subsidize the conilon coffee breeding program, mostly focused on the product quality, for its chemical composition, beverage and other characteristics of interest in the industrial segment. This partnership will provide the necessary conditions for the introduction of new genetic material of the species kept in that company's germplasm bank (Figure 2B).

With the same level of importance, Incaper participates in an international technical cooperation with Embrapa and the Center for International Cooperation in Agronomic Research for Development (CIRAD) in France, which in order to study drought tolerance mechanisms and develop new biotechnological tools that will facilitate the selection and development of new coffee varieties with this important characteristic (Figure 2C).

In 2007, Incaper edited the book *Café Conilon*, a work that gathered all the knowledge generated for this culture to date, which was prepared by 57 authors, reviewed by more than 30

experts, with the participation of 15 institutions. This book edition created a unique technical and literary reference as an instrument of frequent consultation by professionals, students and other public that work with the culture.

Figure 2. Visits of professionals from countries of Africa (A), Nestlé (B) and Cirad-France (C) to know the conilon research and coffee plantations in the State of Espírito Santo.

This work has fulfilled its role and naturally demands a new updated edition, in light of the moment state of the art, since knowledge is a dynamic factor, and almost a decade after the first publication, updates, proofreads, extensions and innovations have become necessary.

Since 2008, the State Government has coordinated a wide Quality Improvement Campaign for Arabica and Conilon Coffees, shared with more than 40 institutions, held every year from mid-May and completing the ninth edition in 2016. In the conilon coffee case, it was also necessary to prioritize the aspects related to quality, since the productivity progress is noticeable, but the market is increasingly demanding products with a higher beverage standard also for this species.

Conilon coffee quality contests, both at the municipal and regional level, were gaining in size and participation from 2009. Cooabriel pioneering has started the Conilon Excellence Competition in 2004, and it completes the 13th edition in 2016. The Special Conilon Pio Corteletti Award, carried out by the Coopeavi cooperative since 2011, is another regional event, with wide coverage.

From 2012, the State Government has coordinated the Special Conilon Award - Conilon State Quality Competition. Currently, in addition to two regional and state competitions, there are about 15 municipal activities, which portrays this new evolution phase of the main quality species of coffee grown in the State of Espírito Santo.

In June 2012, the year in which the conilon centenary in Espírito Santo was celebrated, the State Government, through the Incaper, coordinated the holding of the *Coffea canephora* International Conference, the greatest scientific technical event of all time for this coffee species.

Also in that year, Incaper launched the Renova Sul Conilon Program, specific to the southern region of Espírito Santo, which presents technical indicators below the state average and very distant from those verified in conilon plantations in the northern region of the State. To have an idea, the 28 municipalities in the northern region average productivity is 43 bags/ha, while in the southern region it is only 28.7 bags/ha.

As a way of correcting this regional, technological and income inequality among coffee

growers, the Institute has established a genetic base in the southern region, which is currently able to provide, with the support of private nurseries, approximately 10 to 15 million superior seedlings per year enabling the renewal of about 5 thousand hectares of coffee plantations in the south.

At the end of 2013, the State Government, under the technical coordination of Incaper, implemented the Correct Limestone Project, also specific for the south-central region of Espírito Santo, with the main objective of increasing the productivity of both arabica and conilon coffees, in the 2,000 beneficiary family properties, selected in 30 municipalities. This high impact and low cost action, still creates demonstrative effects to the producers, in order to make soil analysis and use limestone within the research recommendations (De MUNER et al., 2013).

However, the year 2013 was also marked by the historic launch of three new clonal varieties by Incaper (Figure 3). 'Diamante ES8112', 'ES8122 - Jequitibá' and 'Centenary ES8132' have cycles of early, intermediate and late ripening and high average yields varying from 80.73 to 88.75 proces. bags/ha. But these varieties great differential is that, for the first time, consumer and industry demands were considered in their conceptions (FERRÃO et al., 2015a, 2015b, 2015c).

Figure 3. Launching of cultivars Diamante, Jequitibá and Centenária in the Experimental Farm of Bananal do Norte/Incaper, Cachoeiro de Itapemirim/ES, in 2013.

Photos: Leonardo Dalcolmo Tononi.

In beverage quality terms, measured by the International *Coffee Quality Institute* (CQI) method, 'Diamante ES8112' reached 77.5 points, considered as a premium beverage, 'ES8122-Jequitibá' scored 79.01 and 'Centenária ES8132', 77.97, the latter two are classified in the Superior/Premium level.

The Incaper Social Balance, performed for the first time by the Institute, with data regarding the year 2013, showed a positive socioeconomic impact of R$1.09 billion, when assessing productivity gains, the production costs reduction and the value aggregation or production expansion resulting from 25 technological solutions developed by the institute (BALANÇO SOCIAL, 2014).

An amount of R$790 million, which is equivalent to 72.5% of the total impact, is the result of coffee-related technologies, the majority of them directed to the conilon.

In 2014, crowning the work developed in science and technology for conilon coffee, Incaper

was the winner of the Inoves Award, a Government of the State of Espírito Santo initiative that stimulates the culture of innovation and entrepreneurship in the public service context. The project Sustainable Genetic Breeding of Conilon Coffee was awarded in the category Results for the Society, an acknowledgment regarding the socioeconomic impacts resulting from Incaper's performance in the generation and socialization of knowledge and technologies for the productive arrangement of this coffee type.

The history, trajectory and main events that have occurred throughout all these years are a good reflection of the origin, evolution and avant-garde of this culture development, especially the coffee growers and technicians talent and vocation and the cooperation and partnership spirit of the Capixaba institutions.

3 BASES FOR THE CONILON COFFEE ADVANCEMENT

There are several explanatory factors for the conilon coffee advancement in the last 20 years, which deserve to be exhaustively analyzed; however, for which this approach is proposed, only two dimensions will be evidenced: technological and methodological.

In the technological dimension, the following points will be approached: conceptual issues, brief description of the main technologies available and important strategies such as clonal gardens and seedlings used to disseminate improved varieties.

In the methodological dimension, the main mechanisms of technology transfer and available extension methods used, the technical publications and the registry of the main technical events and the most important technologies transfer actions in conilon coffee cultivation are exposed.

3.1 THE TECHNOLOGICAL BASE

3.1.1 Major technologies and technological innovations that have been contributing to conilon coffee evolution

The values that portray the agribusiness *performance* of conilon coffee from Espírito Santo reveal a series of factors responsible for the stage in which it is. Without them, the State would have little chance of sustaining, for a long time, its current prominent position on the national and international scenario.

One of the factors refers to the generated, adapted and available technological apparatus. Certainly, it was the technological innovations added to the agricultural vocation, especially for the conilon coffee cultivation, the entrepreneurial capacity of the coffee growers and the institutional competences existing in the State that built this positive reality.

In this context, emphasis will be given to the technological aspects as a competitive differential and advances generator in the conilon coffee cultivation of the State.

The technology is, in general, the meeting between science and engineering, and as such,

if used properly, has the power to transform realities. It is a social good, because it seeks to find solutions to practical problems produced by environmental forces, with impacts on people. Technology can be defined as the ordered and systematic set of basic knowledge, patented or not, capable of putting an idea into practice. More specifically, it can be defined as procedures, processes and products generated by the research, incorporated or capable of being incorporated in the productive process of a given product (CADERNOS..., 1984).

Not rarely, the terms technology and technological innovation are inadvertently used as synonymous. Innovation is the idea, practice or object perceived as new by an individual. It matters little if the idea is objectively new when measured by the time lapse since its first use or discovery. It is the perceived newness. If an idea seems original to the individual, it is an innovation. New to an innovative idea, need not be simply original knowledge. Innovation, therefore, is the introduction of technologically novel products or processes that promote some improvement type considered significant for a given environment.

Throughout the last 30 years, the State of Espírito Santo has built a solid technological base for the conilon, enough not only to lead and remain at the scientific production forefront. It also served to quadruple the state's productivity average in this period. This achievement is associated with the adoption of improved varieties, liming and balanced fertilization, pruning and suitable pinching, dense plantings, irrigation and others, that were able to transform the conilon coffee plantation into one of the most competitive in the world.

There are numerous technologies (Figure 4 and Table 1) already widely known and incorporated into the production process. However, there are still many technological innovations that require a greater effort to be considered in the context of the productive process.

Figure 4. Harvest with the 'Emcapa 8141 - Robustão Capixaba' variety implanted and conducted following the technical recommendations of the culture in the State of Espírito Santo.

The following, is a summary description of a knowledge set, technologies and innovations specifically developed for conilon coffee, without the intention of establishing a complete technological inventory. More details are found in the different chapters of the book (Table1).

Table 1. Main technologies, knowledge and innovations and their descriptive syntheses that have been contributing to the conilon coffee culture advancement

(to be continued)

Technologies, Knowledge and Innovations	Description
Biotechnology Genetic Breeding	
• Cultivar Emcapa 8111	Clonal variety, launched in 1993, constituted by the grouping of 9 early ripening clones.
• Cultivar Emcapa 8121	Clonal variety, launched in 1993, constituted by the grouping of 14 intermediate ripening clones.
• Cultivar Emcapa 8131	Clonal variety, launched in 1993, constituted by the grouping of 9 late ripening clones.
• Cultivar Emcapa 8141 - Robustão Capixaba	Clonal variety, launched in 1999, consisting of 10 drought tolerant clones.
• Cultivar Emcaper 8151 - Robusta Tropical	Seed propagated variety, launched in 2000, constituted by the recombination of 53 clones.
• Cultivar Vitória Incaper 8142	A clonal variety, launched in 2004, consists of a group of 13 superior clones, that concomitantly present high productivity, general adaptability, production stability, drought tolerance, moderate resistance to rust, large beans and low mocha percentage.
• Cultivar Diamante ES8112	Protected clonal cultivar, launched in 2013, constituted by the grouping of 9 compatible early ripening superior clones with harvesting performed in May. It presents average yields of 80.73 and more than 120.00 bags/ha in non irrigated and irrigated conditions, respectively, maturity uniformity, large beans, drought tolerance, moderate tolerance to rust and superior quality of beverage.
• Cultivar ES8122 - Jequitibá	Protected clonal cultivar, launched in 2013, constituted by the grouping of 9 compatible intermediate ripening superior clones with harvesting performed in June. It presents average yields of 88.75 and more than 120,00 bags/ha in non irrigated and irrigated conditions, respectively, maturity uniformity, large beans, drought tolerance, moderate tolerance to rust and superior quality of beverage.
• Cultivar Centenária ES8132	Protected clonal cultivar, launched in 2013, constituted by the grouping of 9 compatible late ripening superior clones with harvesting performed in July. It presents average yields of 82.36 and more than 120,00 bags/ha in non irrigated and irrigated conditions, respectively, maturity uniformity, large beans, drought tolerance, moderate tolerance to rust and superior quality of beverage.
• Cultivar Marilândia ES8143	Cultivar clonal launched in 2017, constituted by the grouping of 12 superior clones, whose main characteristic is the tolerance to drought.
• Cultivar Verdebras G 30 e G 35	Clonal varieties launched in the 1980's by Verdebras.
• Cultivar SV 2010	Variety recorded by José Jânio Bizi.
• Cultivar Ipiranga 501	Variety recorded by Francisco Luis da Silva Felner.
• Cultivar Colatina PR6	Variety recorded by the Procafé Foundation.
• Genetic parameters estimation	Genetic parameters estimation for the main conilon coffee agronomic characteristics, characterizing the existence of genetic variability among the studied materials.
• Genotype x environment interaction	Studies that show the differentiated behavior of the genetic materials with the environmental variation and provide the indication of the appropriate places to conduct research in genetic breeding in the State of Espírito Santo.
• Production adaptability and stability	Studies that identify general adaptation materials for favorable, unfavorable environments and inference about behavior and genotypes predictability.
• Genetic divergence using agronomic traits	Studies that identify promising parents for hybridization and quantification of conilon genetic variability in the State.
• Behavior repeatability of conilon coffee genotypes	Studies that define a more suitable method for accurately estimating the real value of genotypes under evaluation, and that four to six harvests are enough to obtain 80-85% accuracy in the real value of the genotypes for the bean yield character.
• improved populations	Based on the results of different experiments and genetic divergence, superior clones with different ripening periods were grouped and the early, intermediate and late base populations formed, which since 1998 have been submitted in isolated fields to the recurrent selection in order to increase the frequency of favorable alleles for the three genetic materials for the different populations.
• Germplasm maintenance and characterization	There are 500 genetic materials of interest in the conilon coffee genetic breeding program that are being maintained *ex situ* and characterized by agronomic and molecular descriptors in a Banco Ativo de Germoplasma – BAG (Active Germplasm Baank).

Source: Incaper (2015).

(continuation)

Technologies, Knowledge and Innovations	Description
Biotechnology Genetic Breeding	
• Coffee Genome	Participation in the conilon coffee genes sequencing and studies related to the functional genome.
• Vegetative propagation	Vegetative propagation technique breeding by cutting and the protocol development of the micropropagation technique via tissue culture.
• Clonal Gardens	Techniques and models were developed and adjusted for the implantation and conduction of clonal gardens for the production of seedlings of improved clonal varieties. Currently there are more than 200 clonal gardens in 53 counties. These clonal gardens have the potential to produce more than 50 million seedlings per year, which have been the basis of the renewal of conilon plantations that have been occurring in the order of 6% to 7% per year.
• Conilon hybrids	Using the results of different experiments and genetic divergence, higher parents were chosen. They were crossed in a controlled way, thus obtaining 80 hybrids that were evaluated in experiments in different environments and years. The results show very promising hybrids, with average yields higher than 120 bags/ha and more than 20% heterosis in relation to the best parent. Parents with high overall combining ability were identified and will be used in breeding strategies.
• Recurrent selection	After two cycles of recurrent selection of early, intermediate and late ripening base populations, the results show expressive genetic gains for different characteristics. These results have been used in the breeding program continuation through sexual and asexual strategies.
• Genetic material genotyping	Based on the experiments and recurrent selection results, genotypes are being carried out in genetic material sets of the breeding program. The results have been very important to accelerate the work in this knowledge area, to identify more productive, drought and disease resistant and superior beverage genotypes.
Phytotechnology and Physiology (implantation and crop management)	
• Zoning of areas suitable for cultivation	It defines the areas suitable for cultivation at altitudes lower than 650 m, average annual temperatures between 22 ºC and 26 ºC, and with a water *deficit* of less than 350 mm / year (chapter 3).
• Planting location	Defines the most suitable places for planting. The most recommended are those with lower declivity, less depleted, with more fertile soils, free of physical impediments and waterlogging, easily accessible and with less predisposition for infection by pathogens or pest infestation.
• Crops Implantation	Definition of the most suitable system of holes and seedlings types preparation for conilon coffee crops implantation.
• Line planting	Technique developed for crops implantation formed by clonal varieties. In addition to promoting improved productivity and production quality, it facilitates crop management and harvesting. Line planting provides a reduction in the production and inoculum dispersion in crops, thus reducing the diseases incidence and severity. The technique allows the identification of the clones that are more resistant to pest and disease attacks, especially of cochineal and rust, allowing the directed and differentiated control, with the inoculum reduction, besides reducing the chemical products application.
• Spacing and planting density	It depends on the cultivar, topography, soil fertility and the technological level to be used, among others (chapter 12). The most suitable spacing is around 3.0 m between lines and 1.0 to 1.5 m between plants totaling 2,222 to 3,333 plants/ha. Inadequate planting spacing and density may lead to favorable microclimate for pathogen infection and increased disease severity and pest infestation.
• Pruning and pinching	Technique related to production stability and/or crops reinvigoration. It is recommended, in accordance with the cultivar, spacing, altitude, technological level, topography, irrigation 10-12 thousand stems per hectare. Besides pruning provides the crop invigoration, productivity increase, production stability and facility of handling and harvesting, favors aeration, which develops a favorable microclimate, leading to inoculum reduction, diseases incidence and severity, progression curve reduction, as well as pest infestation.
• Programmed Cycle Pruning	Pruning improvement technique to be carried out every year, after harvesting, by the removal of horizontal and vertical branches, following the technology recommendations. Programmed Cycle Pruning presents the following advantages: reduction of more than 30% of the workforce compared to traditional pruning, ease of understanding and executing it, pruning management standardization, greater ease of cropping and intercropping, greater uniformity flowering and fruits ripening, improvement in pest and disease management, increase of more than 20% in production and improvement in final product quality.
• Banding	Plant management technique developed in 2008, which consists of banding and management of the coffee seedlings after 90 days of planting, aiming at the shoots emission, which after the planting, establishes 3 to 4 vertical stems per plant and 10 to 12 thousand productive rods per hectare. The main importance of the technology is to prepare the plant for Programmed Cycle Pruning, to improve productivity, especially in the first harvesting and to ease crop management.

(continuation)

Technologies, Knowledge and Innovations	Description
Phytotechnology and Physiology (implantation and crop management)	
• Mechanical harvesting	Through joint efforts involving teaching and research institutions, private companies, cooperatives and producers have been worked on technologies development and/or adaptation aimed at the conilon coffee harvesting mechanization. The works have been in the agricultural area, whose objective is the development of crops implantation and management technologies obtaining, therefore, suitable conditions for this type of harvesting. On the other hand, different companies have been developing and/or adapting different types of machines and harvesting systems for this purpose. The results, still preliminary, are promising, with more than 80% efficiency, with shorter operation time and a reduction of more than 30% of the harvesting cost.
• Soil management and conservation	Determination of weed management methods by mechanical and chemical means. Such conservation practices contribute to the erosion control, enrich and help soil moisture maintenance, reduce the presence of pathogens, favor the microorganism's balance in the environment and promote the pathogens and pests biological control. The natural vegetation management in the "streets" of coffee plantation reduces up to 80% of soil losses and 60% of water losses.
• Windbreak	Technique that brings many benefits to the plantations, since the conilon coffee does not withstand strong, cold and continuous winds. It contributes to the reduction of evapotranspiration, maintenance, soil moisture, reduction of aerial part pathogens infection and acts as a barrier to the inoculum dissemination, mainly fungal diseases.
• Management for organic and sustainable coffee production	Afforestation and shading: Various arrangements have been recommended for coffee associated with papaya, rubber, coconut, banana, among other species- these arrangements have proven to be technically, economically and ecologically viable. Legumes in green manure, organic compounds and coffee straw are nutrient sources, conserve the soil, reduce the presence of pathogens, favor the microbiota balance and promote the biological control of pathogens and pests and the induced resistance of plants to diseases. Glue traps, plant extract (neem, Chagas hexanic, white weed) - natural pest control.
• Viçosa mixture, Lime Sulfur and Supermagro (CRUZ FILHO, CHAVES, 1985)	Viçosa mixture- control diseases of the aerial part of the plant with emphasis on rust and leaf spot. Lime Sulfur- diseases and pests control. Supermagro- disease control and pest disinfestation.
• Plant growth rate	Study that defines the conilon coffee curve and growth rate. Knowledge that allows monitoring the conilon coffee nutrition and fertilization in traditional, organic and fertigation systems with unfolding that allow a better understanding of the growth physiology and management practices (pruning) adopted for the crop.
Fertilizers and Liming	
• Recommendation of fertilization and liming for the training and production phases	The studies led to the 1st, 2nd and 3rd approximations for adequate fertilization and liming recommendations. The N, P, B, Zn and organic matter doses were determined for the formation and production phases, as well as N and P doses in dense planting systems. Through soil and leaf analyzes, the nutrient level and balance are verified, which are very important in the fertilization and liming recommendation and in the identification of the plant predisposition to infection by pathogens or pest infestation. Proper fertilization and liming favor the plants nutritional balance, control the presence of pathogens in the soil and promote resistance induced to pathogens and pests.
• Conilon coffee DRIS	Regulation establishment and development of DRIS *Software*. The DRIS method is used for crop nutritional diagnosis and fertilization recommendation.
• Nutritional diagnosis	Critical level determination and leaf concentrations critical ranges, N, P, K, Ca, Mg, S, Fe, Zn, Mn, B and Cu curve and accumulation rate in various organs of the plant. Seasonal fluctuation of nutrient contents and their partition in the different conilon coffee organs.
• Agricultural gypsum use	The studies carried out on the types of Crystalline and dystrophic Red Yellow Latosol soils in the north of Espírito Santo showed that the gypsum application in the bottom of the hole or thrown on already established plantations promotes the coffee root system deepening. It is a technically feasible option for greater coexistence with the conilon coffee drought.
Phytopathology	
• Sanitary analysis and seed treatment	Determines the presence of pathogens and reduces the initial inoculum that usually initiates disease epidemics. Eliminates the presence of pathogens and pests in the seeds.
• Seedlings substrate treatment	EEliminates pathogens and pests present on the substrate, preventing the epidemics onset or pests foci.
• Formation of seedlings	Prevents infection by pathogens and abiotic deformations that may compromise plants in the future.

(conclusion)

Technologies, Knowledge and Innovations	Description
Phytopathology	
• Rust monitoring and control	Rust has been the main conilon coffee disease in Brazil. Rust monitoring establishes critical levels for control and choice of the most appropriate product. The disease severity is determined by a grade scale, which enables the definition of the genetic material resistance and the epidemiological curves. Knowledge of different breeds helps in defining the most suitable practices. Resistant cultivars, nutrition and proper management of the crop are efficient practices in the rust control.
• Mycotoxins in beans	Determines the presence of toxigenic fungi in coffee beans and their effects on the final product quality. It establishes the appropriate conditions of management, handling, harvesting, drying and storage that do not favor the mycotoxins presence in beans.
Entomology	
• Coffee borer monitoring and control	The coffee borer has been the main conilon coffee pest. It has significantly affected the productivity and the final quality of the product. A set of actions has been used to reduce natural coffee borer infestation. Monitoring establishes the critical levels of the pest attack, sets the right time for the practice, and indicates the need to adopt pest chemical control. Proper harvesting and the transfer, the biological control and the ethanol trap have been efficient techniques for capturing and monitoring the coffee borer. Rational use of the chemical has been recommended, in extreme cases, after monitoring the harvest.
• Rosette cochineal monitoring and control	It is recommended to monitor the pest from pre-flowering. The most efficient control, if necessary, should be carried out from the flowering phase to the period of bean filling. For higher efficiency, it is recommended to spray insecticides with a high volume of mixture, with the use of silicon adhesive spreaders, aiming at the internal wetting of the plant and attaining the target pest inside the rosettes.
• Rosette caterpillar diagnosis	Prague, whose damages can be confused by the producer with the rosette cochineal infestation. In some regions, the damage is more intense than that of cochineal. The pest is sensitive to most of the insecticides registered for the coffee cultivation.
• Red mite monitoring and control	Prague that usually appears in dry periods, with long summers. The main symptom is the appearance of lesions that lead to the leaves tanning. The control should be performed with sulfur based products.
• Moth	Conilon coffee quarantine pest. Causes great damage. If not properly managed, it can lead to the need for eradication and crop destruction. Control is recommended by removing the attacked parts of the plant and, consequently, by eliminating the various stages of the insect development: egg, larva, pupa and adult.
Irrigation	
• Irrigation management	Irrigation has been one of the technologies that has offered greater security to the producer in improving productivity of production quality. The studies have defined the times and phases of greater water demands, the irrigation shift, the efficiency and the advantages and disadvantages of the different irrigation equipment. The inadequate irrigation management conditions the emergence of microclimate favorable to the infection of pathogens and increased disease severity and pest infestation.
Sistema de Informações Agrometeorológicos do Estado do Espírito Santo - Siag (Agrometeorological Information System of the State of Espírito Santo)	
• Climate monitoring	An important tool for the climate monitoring of conilon coffee producing regions. Provides information on fires, weather forecast, climate, drought, floods, consecutive dry days (summer), temperature, rain, humidity, winds. The information provides conditions for better management of coffee activity, such as planting, fertilization, irrigation, pest and disease management and/or control, harvesting, drying, among other practices.
Improvement of Final Product Quality	
• Harvesting and post-harvesting management and studies of the beans chemical composition.	Main technologies that have promoted the coffee final quality involving crop management, harvesting, drying time and temperature and the peeled cherry conilon coffee production process. Recently, studies have been carried out on the beans chemical composition, associated with aroma, flavor, body, acidity and other important components involved in determining the final quality of the product. The new clonal cultivars Diamante, Jequitibá and Centenária are constituted by clones with proven superior quality of beverage.
• Wastewater from the coffee processing.	Studies on the destinations and use of the wastewater originated from the processes of pulping and/or coffee peeling.

Source: Incaper (2015).

3.1.2 The Clonal Gardens Strategy

The installation of conilon coffee clonal gardens in the State of Espírito Santo has been the main strategy for the technology diffusion and transfer, especially those coming from the research process on genetic improvement.

This program has been successfully developed since 1993 by Incaper's first clonal varieties, with an impressive *performance* during the 22 years of technology transfer work for the conilon coffee area renovation (Figure 5).

Figure 5. Training for technicians, nurseries and farmers on the Experimental Farms of Incaper.

The first partners of the State in the clonal gardens implementation were the Municipal Governments of Águia Branca, Boa Esperança, Jaguaré, João Neiva and São Gabriel da Palha, as well as Cooabriel, which currently has about 30 thousand parent plant, the largest clonal garden of the State (FONSECA et al., 2005b), with the potential for production of more than 4 million clonal seedlings per year.

As the actions of diffusion and transfer of technologies are developed (lectures, courses, meetings, field days, visits to experimental farms of Incaper, etc.), extend up and diversify to the entities interested in installing their own clonal gardens.

With service criteria clearly defined by the State, prioritization was given to municipal governments, representative entities of family farmers and the Agro-Technical Schools of the official network of the Movimento de Educação Promocional do Espírito Santo - Mepes (Promotional Education Movement of Espírito Santo) and of the Centro Estadual Integration de Educação Rural - Ceier (State Integrated Center for Rural Education), extending later the service to other entities, including the private nursery owners who pay to have access to the seedlings.

The program seeks, first and foremost, to facilitate the access of family farmers to the technologies set. For this, a balanced distribution of clonal gardens occurs in the main producing areas of the State facilitating the technology incorporation process into the production systems. In addition, the availability of genetic material contained in the parent plants fields implemented in the Experimental Farms of Incaper, located in the municipalities of Marilandia and Sooretama is not enough to meet the total state demand.

In 2004, another field of parent plants (clonal garden) was implemented at the Experimental Farm of Bananal do Norte/Incaper - Cachoeiro do Itapemirim as an important base to boost coffee production in the southern region, which has a productivity below the state average, although it has better soil and edaphoclimatic conditions than the northern region (Figure 6). Currently, there are 5 clonal gardens with potential for production and availability of more than 1 million cuttings per year of varieties generated by Incaper for producers in the south of Espírito Santo.

Figure 6. Clonal gardens of the Robustão Capixaba and Conilon Vitória varieties, Bananal do Norte Experimental Farm/Incaper - Cachoeiro de Itapemirim/ES.

In fact, the clonal gardens set forms the multiplier base of genetic material, the result of scientific research with conilon coffee, and it composes the structure and support of technology transfer for the adoption of superior varieties. This work has become a factor of approximation and articulation of the State with the entities and nurseries that contribute to the promotion of advances in conilon coffee.

Currently, the clonal gardens are under the control of five large user groups: the municipal governments, through their municipal agriculture departments or similar, producer associations, including cooperatives; research farms; agro-technical schools and nurseries. Altogether, more than 200 units are added, with a tendency to increase, given the existing demand. They are present in 60 municipalities, with a potential for annual production of more than 50 million seedlings, sufficient for the renewal of approximately 7% of the conilon coffee area per year (Figure 7).

3.1.3 Seedlings nurseries

They are facilities duly registered in the Mapa, that are used for technology reproduction, via seeds, by vegetative propagation or cloning.

The operation result of a set of techniques recommended by the official production manuals in accordance with the specific current legislation has as final product the seedling that should confer a desirable quality standard (FONSECA et al., 2005b).

The seedling, therefore, is the technology materialization that, multiplied in scale, becomes one of the vectors of innovations transfer and, ultimately, changes the crops profile.

Most of the positive changes in conilon coffee cultivation in the State are due to the seedling production evolution.

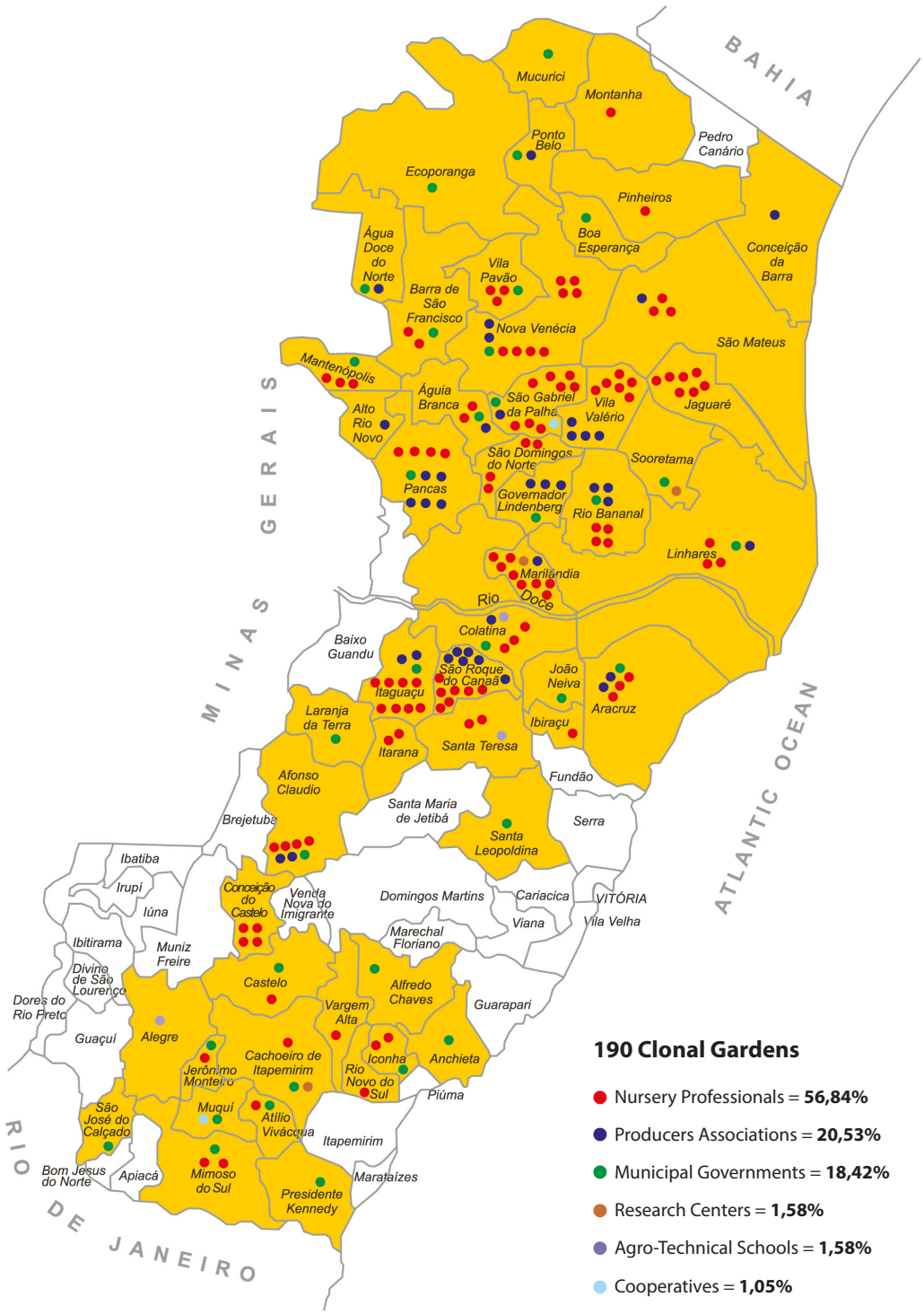

Figure 7. Spatial distribution of conilon coffee clonal gardens in the State of Espírito Santo.

Source: Incaper (2015).

Taking into account that the majority of nursery farmers have produced seedlings of the varieties recommended by the research, it can be concluded that this work has been essential for the conilon coffee cultivation technological base alteration in the State.

The improved varieties have been constituted based on the crops renewal in Espírito Santo It is estimated that more than 60% of the conilon area in Espírito Santo has already been renewed in new technological bases, from the varieties or clones developed by Incaper.

Many technicians in the field consider the improved varieties, especially when associated with irrigation, nutrition and well-managed pruning technologies, which are responsible for the positive leap in average coffee conilon productivity in the State.

In Espírito Santo, the growth in the number of conilon coffee seedlings nurseries registered and the evolution in the production of quality seedlings are directly related to the availability of improved varieties and with the supervision required by Mapa, carried out by its regional of Cachoeiro de Itapemirim, Linhares, Venda Nova do Imigrante and Colatina.

The availability of improved varieties, especially the clonal ones, demands from the nursery professional a greater technical refinement of production, as well as the intrinsic care of this type of technology, since it requires knowledge regarding the set of clones that compose it (FERRÃO et al., 2012).

In order to produce quality seedlings, it is necessary to invest in suitable facilities, materials and equipment that last longer, either for coverage and reduction of insolation, or for the nursery side protection order to provide adequate levels of temperature and relative humidity, which will result in efficiency in the production process (Figure 8).

Figure 8. Clonal seedlings in nursery covered with shaded cloth in the Experimental Farm of Marilândia/ Incaper, Marilândia/ES.

On the other hand, the supervisory actions undertaken in recent years were more active and consistent. In this way, the nursery professionals had to know and execute the specific

legislation, adapting their enterprises to it, consolidating, thus, in a market that is already considered very competitive.

These observations allow us to conclude that the State of Espírito Santo has a good base in the production of quality seedlings.

Incaper has strongly contributed to the provision of propagating materials (cuttings and/or seedlings) and guidance in the clonal gardens implementation and management. The Institute will continue with this purpose using the structures of the three experimental farms, which have the potential for producing more than 2 million cuttings per year.

According to Mapa, in 2014, the State had 278 nurseries registered/approved as conilon seedlings producers, with a production capacity of 81.5 million seedlings (Table 2).

Table 2. Number of coffee nurseries approved by Mapa/SFA-ES in the State of Espírito Santo, in 2014

Afonso Cláudio	3	João Neiva	2
Água Doce do Norte	1	Laranja da Terra	1
Águia Branca	8	Linhares	6
Alegre	3	Mantenópolis	4
Alto Rio Novo	3	Marechal Floriano	2
Aracruz	5	Marilândia	23
Barra de São Francisco	3	Mimoso do Sul	1
Boa Esperança	3	Montanha	2
Brejetuba	4	Nova Venécia	8
Cachoeiro de Itapemirim	1	Pancas	6
Castelo	2	Pinheiros	2
Colatina	4	Rio Bananal	19
Dores do Rio Preto	2	Rio Novo do Sul	1
Ecoporanga	2	Santa Leopoldina	1
Fundão	2	Santa Maria de Jetibá	4
Governador Lindenberg	6	Santa Teresa	10
Guaçuí	1	São Domingos do Norte	6
Ibatiba	1	São Gabriel da Palha	13
Ibitirama	1	São Mateus	13
Iconha	2	São Roque do Canaã	2
Irupi	2	Sooretama	5
Itaguaçu	15	Venda Nova do Imigrante	4
Itarana	1	Vila Pavão	7
Iúna	7	Vila Valério	22
Jaguaré	31		
Jerônimo Monteiro	1	**Total**	**278**

Source: Ministry of Agriculture, Livestock and Supply-Mapa/SFA-ES (2014).

Most nursery professionals work on demand or order, thus avoiding losses caused by market retraction or lack of standardization of seedlings that grow older and are not ideal for planting.

Normally, there is a percentage between 90 and 95% of seedlings produced in relation to the homologated total.

3.2 THE METHODOLOGICAL BASE

The conilon coffee production in Espírito Santo is delineated in a dynamic and constantly evolving environment. The stage of technical progress achieved, the effort to transfer technologies and the perception of coffee growers regarding the need to incorporate innovations in crops have produced in the State an extensive agenda of events with the objective of facilitating access to technological innovations.

There are numerous methodological actions of a motivational, informative and, specifically, technologies transfer character carried out in recent years, guided towards the reach of individual, group and mass producers.

Several institutions are components of the conilon coffee production chain that have presented different ways of approaching rural producers. All of them, with their own peculiar characteristics, have used the main methods of extension to promote favorable contact environments with the technological innovations.

These transfer actions initiatives, in general, have been developed in an institutional partnership process of support, accomplishment and promotion, which has rationalized resources and materials, reducing the action final cost.

Therefore, what has been achieved through the incorporation of technologies into the production process and changes in the conilon plantations technological profile in the State of Espírito Santo is the result of integrated work with coffee growers and these entities, in a more collective and less individual way.

3.2.1 The methodologies

In the last 20 years, various extension methods by the institutions have been used to bring together coffee growers for the knowledge dissemination. In a quick analysis, these methods can be separated into two slopes: individual methodologies and group methodologies.

Due to the lack of records and reports of most institutions that develop transfer methodologies in the State, it is not possible to discuss individually or to structure a consolidated framework of the joint effort of this work over the past years. However, with Incaper's official reports, it is possible to recover and present a significant portion of these actions, which, in turn, were developed almost always with the active participation of the other entities in the conilon coffee production chain.

The individual methodologies used for technical assistance are important because they establish a direct relationship between technicians and farmers by customizing the guidance, which allows a reduction in the time for the adoption of knowledge and technologies that improve farm technical indicators and increase the income of rural families.

The Incaper uses, as individual methods, the technical visits, which are procedures

programmed between the extension agents and the coffee growers, as well as contacts and appointments, which are casual and unscheduled, as they consist of on-demand service in the offices or in any other place or means of communication, where there is a dialogue between the extension technician and the farmer.

Between 2011 and 2014, the official extension service of the Government of Espírito Santo carried out more than 49.1 thousand individual methods to assist the Capixaba conilon coffee growers, between technical visits and appointment/contact, with an annual average of 12.3 thousand personalized assistance. Individual methods are also growing every year, rising from 9.5 thousand in 2011 to 14.4 thousand in 2014, an increase of almost 52% in this short period (Table 3).

Table 3. Individual rural extension methodologies developed by Incaper for conilon coffee in the State of Espírito Santo, from 2011 to 2014

Individual Methodologies	Unity	Years				Total	Average/year
		2011	2012	2013	2014		
Visit	number	5,310	4,237	4,712	5,463	19,722	4,930.5
Appointment/Contact	number	4,207	7,019	9,182	8,972	29,380	7,345.0
Total	**number**	**9,517**	**11,256**	**13,894**	**14,435**	**49,102**	**12,275.5**

Source: Original Data from the Department of Planning and Fundraising (DPC)/Incaper, 2015.

Group methodologies may, for the purpose of understanding, be subdivided into four groups.

In the first group, courses, methods demonstrations and results, field days, special days, technical excursions and productivity competitions were prioritized, as they enabled and associated motivational effects, combined with emancipatory actions for coffee growers (Figure 9).

Figure 9. Field day to demonstrate the performance of Incaper's improved varieties.

In the second group of methods, there are the producers meetings, the various forms of gatherings (symposiums, seminars and congresses, with their panels, lectures and debates), of a technical, informative and exchange nature. This set of methods is important to create technological and entrepreneurial awareness for coffee growers, but it has no clear goals of technology transfer in the first instance.

In the third group are the different campaigns types used by rural extension. This methodology is considered complex, because it involves an association of methods that, depending on the objectives and the action nature, may include several other methods already mentioned. It also requires, in most cases, the edition of technical publication of printed material in an educational and advertising way, as well as the insertion of the mass media (TV, radio, newspaper and internet), as a way of broadening the action reach. Despite the generally high cost, the campaign, when well planned and executed, has striking and long lasting results.

It should be emphasized that, more than any other extension methodology, the campaign, because it is considered a complex and expensive method, should have maximum institutional involvement. As an example of this methodology success, the coffee pruning campaigns (1994), the coffee borer control (2000), the use of liming (2002) and Quality and Productivity Improvement from 2009 stand out.

Finally, two other methodologies, which are basic to the extension worker, were used to facilitate the process of technology transfer. These are the demonstration and observation units. The first is to implant a small crop, preferably in areas belonging to producers, containing the technology that is to be demonstrated for adoption purposes. It is also possible to take advantage of an already established producer's crop, bordering the area intended to be innovated, and when the effect of this action is positively contrasting, it makes the methodological use of the demonstration unit, planning visits from other producers, promoting excursions, field days and other events.

The observation unit is a methodology that serves to give the extension agent security and certainty about a particular innovation, before promoting technology transfer actions. Initially, it is closed to public visitation, but after confirming the technology performance, it can be transformed into a demo unit and have the same previous procedure.

They are methodologies for sustaining extension work in a place or region, since, by their own intrinsic characteristics, they allow visual comparisons and exert complex demonstrative effects (Figure 10).

Figure 10. Technical guidelines to conilon coffee growers in the State of Espírito Santo.

It can be seen from Table 4 that Incaper's technology transfer effort from 2011 to 2014 was extraordinary, making it possible to use practically all available extension methodologies. During this four-year period, 3,512 group methodologies were carried out, at an average of 878 per year, corresponding to the extraordinary mark of 4.4 events per Institute working day.

Table 4. Main rural extension methodologies developed by Incaper for conilon coffee in the State of Espírito Santo, from 2011 to 2014

Group Methodologies	Unity	Years			
		2011	2012	2013	2014
Field Day	number	10	10	13	17
Meeting held	number	299	255	257	185
Method Demonstration	number	386	370	487	586
Demonstration Unit	number	31	24	38	25
Excursion	number	45	36	61	29
Course	number	21	27	32	29
Meeting	number	26	14	15	13
Symposium	number	1	0	1	0
Campaign	number	1	1	1	1
Observation Unit	number	2	3	10	9
Workshop	number	1	8	0	1
DRP	number	0	1	6	3
Seminar	number	1	3	2	1
Special day	number	5	3	4	4
Lecture	number	s/i	7	54	25
Result demonstration	number	5	4	6	3
Total	**number**	**832**	**765**	**985**	**930**

Source: Incaper (2015).

3.2.2 Assistance to the conilon producer

In order to analyze the technical assistance to coffee growers, it is necessary to establish the context in which the activity is inserted as a reference.

The conilon coffee industry is already present in 64 of the 78 municipalities of the State of Espírito Santo, in more than 40 thousand rural properties, involving about 78 thousand families in the field. The workforce is comprised of 47% of owners, 47% of rural partners and 6% of employees, demonstrating the importance of family farming and its economic, social and environmental consequences in production relations (PEDEAG, 2003).

It is in this context that technical assistance services and representative organizations of coffee growers are involved. As has already been reported, there are several institutions providing such services in the State. In addition to Incaper's official service, cooperatives, associations, rural and workers' unions, and private companies have their own methodological approaches, technical staff, and their own public service programs (Figure 11).

In the absence of systematic records of this service provision, the focus of these individual participation institutions is reported in Chapter 28, Institutional Arrangement of Conilon

Coffee Growers in the State of Espírito Santo, in this publication. However, in order to know a significant parcel of the service to conilon coffee with technical and managerial guidance, the analysis is based on the Incaper's report data.

Table 5 shows that, over the last five years, Incaper's number of services to the conilon producer ranged from 15.9 to 20.7 thousand beneficiaries, representing an annual average for the period that comprises the years of 2010 and 2014, of 18 thousand assists, without repetition.

Table 5. People attended by Incaper in conilon coffee activity, in the State of Espírito Santo, from 2010 to 2014

Discrimination	Unity	Years					Average (2010/ 2014)
		2010	2011	2012	2013	2014	
Public assisted	people	16.452	15.877	18.361	20.705	18.735	18.026

Source: Incaper (2015).

It is recorded that Incaper considers as public assisted in its reports the coffee growers owners and the coffee growers partners or sharecroppers, a typical and common situation for the State of Espírito Santo. Therefore, it is estimated that the 18 thousand people assisted on average per year work in about 10 thousand coffee farms, which represents around 25% of the total Capixaba properties that grow conilon coffee.

It should also be noted that the conilon coffee growers are those who lead the technical assistance provided by Incaper in relation to the other activities/areas monitored by the organ (Figure 11).

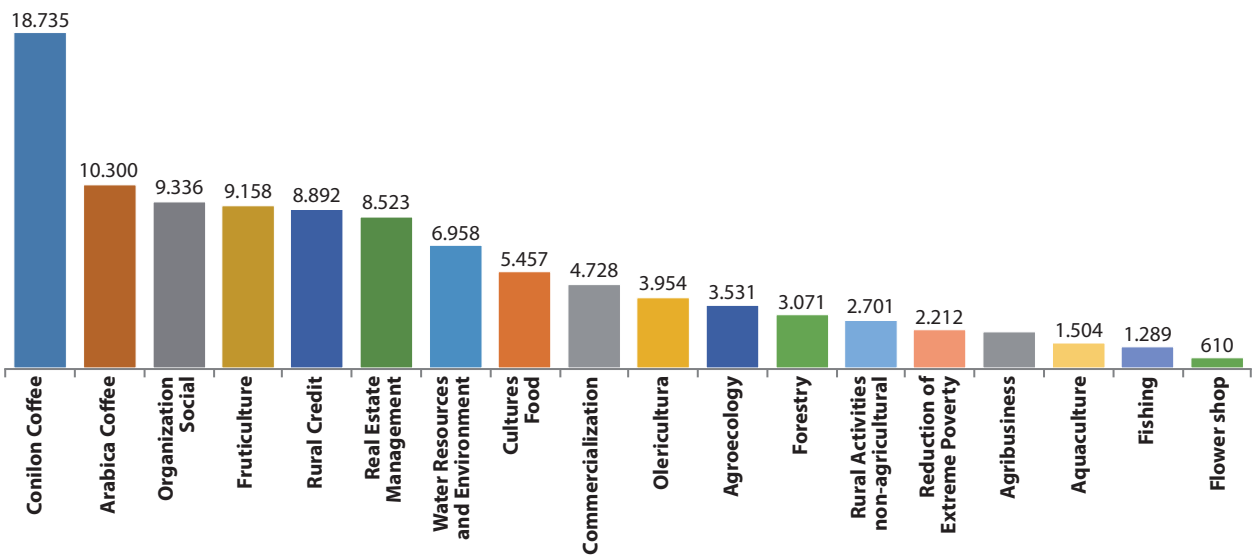

Figure 11. Public assisted by Incaper, per activity, in 2014.

Source: Incaper (2015).

The direct assistance to the coffee growers tends to grow, thanks to Incaper's professional staff, the increasing involvement of municipal governments through their Agricultural

Department the services provision by rural organizations, the active participation of the private sector and the institutional partnerships that have been expanded.

3.2.3 Technical publications

In a scientific and technological environment, information, knowledge and technologies are recorded in specific dissemination vehicles, serial or not, as another way of disseminating the science advances. This strategy, besides facilitating access to innovations, allows society as a whole to take ownership of them, incorporating them into their way of life or production.

In general, we can distinguish three groups of technical publications that are characterized by the people to which they are directed, by the text structure and by the language used.

In the first group are the dissemination vehicles directed to the, national and international academic-scientific community (university professors, extension agents and researchers). These are specialized scientific journals, congresses annual books, symposia, seminars and research forms written in technical-scientific language, containing research reports and presented according to the usual structure of scientific articles.

In the second, there are the publications written in technical language, containing recommendations and information in a succinct and objective way, fueled by technical scientific work or research observations. In this group are basically books, circular technique, technical folders, technical communicates and reports, manuals and specialized journals. They are designed and directed preferably to development agents working in the field of technical assistance and, occasionally, to producers with proper technical level.

The third group of publications is composed of language directly headed to farmers. They are booklets, folders, leaflets, newspapers and newsletters.

The scientific production growth for conilon coffee and the need for rapid dissemination of research results to coffee growers have led to the production and edition of an important portfolio of technical publications, which have been the main source of consultation and technical leveling of agents in the conilon coffee agroindustrial chain. (Figure 12).

The main available publications that refer in whole or in part to conilon coffee, especially those in the second and third groups, which are registered in the Incaper Library, are detailed in Table 6. It should be noted, therefore, that despite the importance, due to the large number of dissertations and master's and doctorate theses, technical-scientific articles published in journals, symposiums annals and congresses were not considered.

Figure 12. Main Incaper publications regarding conilon coffee.

Table 6. Main technical publications on conilon coffee directed to the Espírito Santo's coffee cultivation, from 1987 to 2015

(to be continued)

Title	Vehicle	Publisher	Edition year
Jornal Cooabriel (Cooabriel Newspaper) - more than 200 editions	Informative	Cooabriel	From 1987
Projeto: renovação de lavouras de café conilon (Project: conilon coffee crops renewal)	Flyer	Emater	1988
A broca-do-café (The coffee-borer)	SD	Emcapa	1989
Incidência de *Orthezia praelonga*, DOUGLAS,1891, em café conilon no Espírito Santo (*Orthezia praelonga* Incidence, DOUGLAS, 1891, in conilon coffee in Espírito Santo)	SD	Emater/Emcapa	1989
Conilon coffee clones selection (*Coffea canephora*) for the State (Seleção de clones de café conilon (*Coffea canephora*) para o Estado)	Ongoing Research	Emcapa	1990
'Emcapa 8111`; ´Emcapa 8121`, ´Emcapa 8131`: Primeiras variedades clonais de café conilon lançadas para o Espírito Santo ('Emcapa 8111'; 'Emcapa 8121', 'Emcapa 8131': First clonal conilon coffee varieties released to Espírito Santo)	Technical communicate	Emcapa	1993
´Emcapa 8111`; ´Emcapa 8121`, ´Emcapa 8131`: Primeiras variedades clonais de café conilon lançadas para o Espírito Santo ('Emcapa 8111`; 'Emcapa 8121`,Emcapa 8131`: First conilon coffee clonal varieties sent to Espírito Santo)	Folder	Emcapa	1993 reprint 1995
A poda do café conilon (Conilon coffee pruning)	SD	Emcapa	1993
Poda de produção do café conilon (Conilon coffee production pruning)	Folder	Emater/Emcapa	1993
Recomendações técnicas para implantação de lavouras de café conilon por meio de mudas clonais: ES (Technical recommendations for the conilon coffee crops implantation through clonal seedlings: ES)	Folder	Emater	1993
Como obter café conilon de boa qualidade (How to obtain good conilon coffee)	Folder	Emater	1993
Café conilon: mudas clonais, critérios para seleção de plantas matrizes (Conilon coffee: clonal seedlings, criteria for parent plants selection)	Booklet	MAARA/PRO CAFÉ DFAARA/ES	1994
Produção de mudas clonais de café conilon em câmara úmida sob cobertura de folhas de palmeira (Production of conilon coffee clonal seedlings in a humid chamber under palm leaf cover)	SD	Emcapa	1995
Manual técnico para a cultura do café no Estado do Espírito Santo (Technical manual for coffee growing in the State of Espírito Santo)	Book	Seag	1995
Análise comparativa da competitividade econômica do eucalipto em relação às explorações tradicionais de café e pecuária no Estado do Espírito Santo (Comparative analysis of the economic competitiveness of eucalyptus in relation to traditional coffee and livestock farms in the state of Espírito Santo)	Booklet	SEEA	1996
Criação massal da vespa-de-uganda e vespa-da-costa-do-marfim, parasitoides da broca-do-café (Massive creation of spider wasp and Ivory Coast wasp, coffee borer parasitoids)	SD	Emcapa	1996
Zoneamento agroecológico para cultura do café no Estado do Espírito Santo (Agroecological zoning for coffee growing in the State of Espírito Santo)	Booklet	Seag	1997
Poda de produção café conilon (Conilon coffee production pruning)	Folder	CCCV/Cetcaf/Fetaes/ Seag	1997
'Emcapa 8141 - Robustão Capixaba': variedade clonal de café conilon tolerante à seca (`Emcapa 8141- Robustão Capixaba': conilon coffee clonal variety tolerant to drought)	Folder	Emcapa	1998

(continuation)

Title	Vehicle	Publisher	Edition year
'Emcapa 8141 - Robustão Capixaba': variedade clonal de café conilon tolerante à seca ('Emcapa 8141- Robustão Capixaba': conilon coffee clonal variety tolerant to drought)	Press Release	Emcapa	1999
'Robusta Tropical - Emcaper 8151': primeira variedade melhorada de café conilon de propagação por sementes para o Espírito Santo ('Robusta Tropical - Emcaper 8151': first improved variety of seed propagation conilon coffee for Espírito Santo)	Folder	Emcaper	2000
Programa de manejo da broca-do-café no Estado do Espírito SantoProdução de mudas de café conilon por semente (Production of conilon coffee seedlings by seed)	Folder	Emcaper	2000
Manejo da broca-do-café (Coffee-borer management)	Folder	Emcaper	2000
Programa de renovação da cafeicultura da região sul do Espírito Santo (Coffee borer management program in the State of Espírito Santo)	Folder	Emcaper	2000
Coffee renewal program in the southern region of Espírito Santo (Programa de renovação da cafeicultura da região sul do Espírito Santo)	Folder	Emcaper	2000
Produção de mudas de café conilon por sementes DRIS – café conilon (Production of conilon coffee seedlings by seeds DRIS-conilon coffee)	DQ-1	Incaper	2000
Dicas de café (Coffee Tips)	SD	incaper	2001
Como produzir café conilon (How to produce conilon coffee)	VHS	Incaper	2001
Como produzir café conilon (How to produce conilon coffee)	Manual	Incaper	2001
Café conilon: adubação e calagem (Conilon coffee: fertilization and liming)	CT	Incaper	2001
Calagem: saiba como fazer e colha muitos benefícios (Liming: learn how to make and harvest many benefits)	Folder	Incaper	2002
Compostagem orgânica da palha de café (Organic composting of coffee straw)	Folder	Incaper	2003
Cafés de qualidade: Espírito Santo colheita e processamento (Quality coffees: Espírito Santo harvesting and processing)	Folder	Incaper	2003
'Conilon Vitória - Incaper 8142`: variedade clonal de café ('Conilon Vitória - Incaper 8142': clonal coffee variety)	SD	Incaper	2004 - 1st ed.
Café conilon: técnicas de produção com variedades melhoradas (Conilon coffee: production techniques with improved varieties)	CT	Incaper	2004 - 1st ed.
'Conilon Vitória - Incaper 8142`: variedade clonal de café ('Conilon Vitória - Incaper 8142': clonal coffee variety)	Folder	Incaper	2004 - 1st ed.
Jardins clonais de café conilon (Conilon coffee clonal gardens)	CT	Incaper	2004 - 1st ed.
Jardins clonais de café conilon - atualizada (Clonal coffee conilon gardens- updated)	CT	Incaper	2005 - 2nd ed.
Café (Coffee)	Report	Incaper	2005
Cafés do Espírito Santo - Brasil (Coffees of Espírito Santo- Brazil)	Folder	Incaper	2005
Brava Gente Polonesa (Brave Polish People)	Book	Jônice Tristão Foundation	2005
Café conilon (Conilon coffee)	Book	Incaper	2007
Quer fazer um café conilon de qualidade? (Do you want to make a quality conilon coffee?)	Folder	Incaper	2008
Seminário para a sustentabilidade da cafeicultura (Seminar on coffee cultivation sustainability)	Book	CCA - Ufes/Incaper	2008
Poda programada de ciclo para o café conilon (Programmed cycle pruning for conilon coffee)	Folder	Incaper	1st/2008 - 2nd/2009

(continuation)

Title	Vehicle	Publisher	Edition year
Como você quer a sua produção de café conilon: mais forte ou mais fraco? Colha o café na hora certa e fortaleça a qualidade do seu produto (How do you want your conilon coffee production: stronger or weaker? Get the coffee on time and strengthen the quality of your product)	Folder	Incaper	2008
Café conilon de qualidade (Quality conilon coffee)	Folder	Incaper	2009
Cetcaf On Line	Informative	Cetcaf	From 2009
Produza seu café com qualidade e colha mais lucros. Colha o café conilon na hora certa e fortaleça a qualidade e o valor dos seu produto (Produce your coffee with quality and harvest more profits. Harvest conilon coffee at the right time and strengthen the quality and value of your product)	Folder	Incaper	2009
Café conilon de qualidade (Quality conilon coffee)	Folder	Incaper	2010
Produza seu café com qualidade. Colha o café conilon na hora certa e fortaleça a qualidade e o valor dos seu produto (Produce your coffee with quality. Harvest conilon coffee at the right time and strengthen the quality and value of your product)	Folder	Incaper	2010
Produza seu café com excelência de qualidade e obtenha mais lucro e melhores oportunidades de mercado (Produce your coffee with quality excellence and get more profit and better market opportunities)	Folder	Incaper	2010
Tecnologias para sustentabilidade da cafeicultura (Technologies for coffee cultivation sustainability)	Book	CCA - Ufes/Incaper	2011
Inovação, difusão e integração: bases para sustentabilidade da cafeicultura (Innovation, diffusion and integration: bases for coffee cultivation sustainability)	Book	CCA - Ufes/Incaper	2012
Conilon Capixaba 100 anos de desafios, crescimento e inovação (Conilon coffee: One hundred years of history and evolution in the State of Espírito Santo. From Brasil to the world)	Folder	Incaper	2012
Conilon capixaba 100 anos de desafios, crescimento e inovação (Capixaba conilon 100 years of challenges, growth and innovation)	Book	Government of the State of Espírito Santo/Seag	2012
100 anos de Conilon Capixaba (100 years of Capixaba Conilon)	Special Newspaper Section	A Gazeta	2012
Conilon: técnicas de produção com variedades melhoradas (Conilon: production techniques with improved varieties)	CT	Incaper	2012
Conilon coffee: Production techniques with improved varieties	CT	Incaper	2012
Café conilon: técnicas de producción com variedades melhoradas (Conilon coffee: production techniques with improved varieties)	CT	Incaper	2012
Manual da Conferência Internacional de *Coffea canephora* (Manual of the *Coffea canephora* International Conference)	Informative	Incaper	2012
Teores de nutrientes nas águas residuárias do café e características químicas do solo após sua aplicação (Nutrient contents in coffee wastewater and soil chemical) characteristics after application	SD	Incaper	2012
Renova café conilon (Renew conilon coffee)	Folder	Incaper	2012
Conilon produza seu café com qualidade (Conilon produce your own coffee with quality)	Folder	Incaper	2013
Variedade clonal de café conilon: 10 passos em 12 anos de pesquisa (Conilon coffee clonal variety 10 steps in 12 years of research)	Folder	Incaper	2013
'Diamante ES8112': nova variedade de café conilon de maturação precoce para o Estado do Espírito Santo ('Diamante ES8112': new variety of early ripening conilon coffee for the State of Espírito Santo)	Folder	Incaper	2013

(conclusion)

Title	Vehicle	Publisher	Edition year
'ES8122' - Jequitibá: nova variedade de café conilon de maturação intermediária para o Estado do Espírito Santo ('ES8122 - Jequitibá': new conilon coffee variety of intermediate ripening for the State of Espírito Santo)	Folder	Incaper	2013
'Centenária ES8132': nova variedade de café conilon de maturação tardia para o Estado do Espírito Santo ('Centenária ES8132': new variety of late-ripening conilon coffee for the State of Espírito Santo)	Folder	Incaper	2013
Calagem (Liming)	Folder	Seag/Incaper	2013
Cafés do Estado do Espírito Santo conilon e arábica (State of Espírito Santo Coffees conilon and arabica)	Folder	Seag/Incaper	2013
Calcário Correto: programa de incentivo à utilização de calcário para a cultura do café na região sul do o Estado do Espírito Santo (Correct Limestone: incentive program for the use of limestone for coffee cultivation in the southern region of the State of Espírito Santo)	Folder	Seag/Incaper	2013
Café Conilon: Qualidade, Adubação e Irrigação (Conilon Coffee: Quality, Fertilization and Irrigation)	Book	Ceunes/Ufes	2013
Café Conilon: Tendências de Mercado e Mecanização (Conilon Coffee: Market Trends and Mechanization)	Book	Ceunes/Ufes	2014
Campanha de qualidade café conilon (Conilon coffee quality campaign)	Folder	Incaper	2014
Campanha de qualidade café conilon (Conilon coffee quality campaign)	Folder	Incaper	2015
Café Conilon: do Plantio à Colheita (Conilon Coffee: from planting to harvesting)	Book	UFV	2015
Café Conilon 2ª Edição (Conilon Coffee 2rd Edition)	Book	Incaper	2017
'Marilândia ES 8143': cultivar clonal de café conilon tolerante a seca para o Espírito Santo ('Marilândia ES 8143': clonal conilon coffee cultivar for the Espírito Santo)	Folder	Incaper	2017
Jardim Clonal Superadensado de Café Conilon: Técnica de multiplicação rápida de variedades melhoradas de café conilon (Conilon Coffee Supercoated Clonal Garden: Rapid multiplication technique of improved conilon coffee varieties)	Folder	Incaper	2017

Note: 1.SD = Documents Serie; CT = Technical Circular; DQ-1 = Diskette.

3.2.4 Greate events

State Symposium on Coffee

Started in 1994 and already accumulating nine editions, the State Symposium on Coffee is traditionally held every two or three years under the coordination of Cetcaf, in a promotional partnership with the Government of the State of Espírito Santo and with the participation of private initiative important institutions, such as the Comércio do Café de Vitória - CCCV (Coffee Trade Center of Vitória) and other auspices that alternate and add to each edition.

This event was created to enable the meeting of the coffee production chain agents and to promote discussion and debates on important and current topics on coffee activity, constituting, over the years, in a technological and marketing referential for all coffee agribusiness.

It is always held in Vitória/ES, which gathers, on average, 400 participants and facilitates

the exchange of coffee growers, brokers, exporters, sales representatives, roasters, researchers, technicians several initiatives and leaders of the coffee agribusiness segments (Figure 13).

Figure 13. State Symposium on Coffee, Vitória/ES, 2013

Photo: www.cetcaf.com.br

It has been characterized as one of the traditional events of information on technological advances updating and leveling, also enabling the discussion and clarification on public policies directed to the sector.

In addition to all the contributions that this event has provided to the process of diffusion and technology transfer, especially related to conilon coffee, its accomplishment has approached the entities that make up this product productive chain.

At each edition, a publication in the form of Annals containing the texts of the lectures, conferences, panels and debates is organized and edited and distributed to the participants in pressed or electronic format.

It established a reference frame of discussion on the activity technological modernization, emphasizing the pursuit of productivity, quality and sustainability.

Conilon Coffee Pruning Campaign

Campaign is a complex rural extension methodology, since, in most cases, it works with other methodologies of individual, group and mass extent. In addition, a technical publication should be edited detailing step by step the content to be communicated. It provides enlightening meetings at strategic points, demonstrations of methods and practical results in addition to the production of video and spot containing advertising messages to be broadcast at pre-programmed times on television and radio stations, respectively.

With the research results obtained by Incaper, which point out among the different advantages of pruning, increase of up to 53.5% in productivity (SILVEIRA et al., 1993), the State Government, through Seag and its related institutions, planned and performed in 1994 a broad pruning campaign for conilon coffee in order to disseminate the use of the technology. In the campaign development, several training were carried out for technicians and producers, meetings in the communities of all the producing municipalities, numerous demonstrations

of the pruning method and executed more than 500 insertions of advertising messages at strategic times on television and on radios, especially those in the State countryside.

Pressed technical publications with technology contents, written in simple language, with figures and schemes to facilitate the understanding have been produced (EMATER; COOABRIEL [199-]).

This campaign was repeated and strengthened in 1997. This time, including the CCCV, Fetaes and Cetcaf as partners. It has been verified over the years that the campaign was very efficient and effective as an extension method, considering that the pruning technique is not only incorporated into the conilon coffee production process, but also has one of the highest adoption rates, compared to other available technologies.

Conilon Coffee Northwest

Coffee growers meeting planned and executed specifically for the northwest region of the State of Espírito Santo. The idea of this event was to promote a specific space for the technology diffusion, to create a presentation and discussion forum on the main technologies, and also to give producers an innovative environment for conilon coffee.

The central idea was to break with the technological stagnation existing in some municipalities of the region that presented low productivity indicators, caused by the low adoption of technologies. Every edition, the event has a different place so that the effect of bringing farmers closer to information is as emblematic as possible.

This journey began in the municipality of Barra de San Francisco in 2005 and now has seven editions (Figure 14).

What has been sought at this event essence is to put coffee growers in direct contact with up-to-date information and knowledge, as well as to demonstrate innovative technologies aiming at renewing crops, following the recommendations, associated with good agricultural practices. What is wanted, therefore, has to do with the change of the farmer's technological profile and of the property aiming, in the end, to increase the productivity average of the region and the improvement of the product final quality.

Figure 14. Northwest Conilon coffee, Barra de São Francisco/ES, 2005.

The region has about 47% of the area planted with conilon coffee and holds 37% of state production and counts with 18 thousand coffee growers.

From the organization point of view, mobilization and motivation of coffee growers, in addition to institutional involvement, the event is of fundamental importance in order to advance towards the regional average.

Brazilian Coffee Research Symposium

Started in 2000, the Symposium is already a traditional forum for presentations and discussion of research works and approaches of important themes for the coffee production

chain and for science and technology.

After the first edition of 2000, in Poços de Caldas/MG, with around 700 participants and 381 scientific papers, the event accomplishes the goal of being the provider of scientific advances in coffee in nine editions, promoted by the Consórcio Brasileiro de Pesquisa e Desenvolvimento do Café - CBP&D/Café (Brazilian Consortium for Research and Development Coffee), under the Coordination of Embrapa and state governments in the places where the event is held.

Always held every two years, 450 to 500 scientific papers are presented each edition with the participation of 700 to 800 congressmen, including representatives of the sectors that make up agribusiness coffee, such as researchers, extension agents, coffee growers, industry representatives, commercial representatives, brokers, specialized press, students and others interested in the advances of coffee science and technology (Figure 15).

Brazil Conilon Coffee Symposium and Cooabriel Conilon Excellence Competition

Started in 1999, this event had six editions held in the city of São Gabriel da Palha/ES, every two years, until 2009. It was always focused on thematic issues that broaden the global vision of the coffee agribusiness to the participants, especially entrepreneurial coffee growers, rural research and extension professionals, business acting in this area and technical and political leaderships of this important State activity.

Figure 15. Coffee Research Symposium of Brazil, Curitiba/PR, 2015.

Photo: www.embrapa.br

The event had as main promoters and organizers the Cooabriel, the Sicoob with partnership of the Municipal Government of São Gabriel da Palha/ES and the State Government, through Seag.

Always attracted by the guarantee of important thematic discussions, the public, which was one of the factors of Brazil Café Conilon success, received information, management knowledge and technologies of coffee properties, production technologies and global agribusiness vision, fundamental for the practice of professional coffee growers.

In its last editions, the Brazil Conilon Coffee Symposium included in its programming the Cooabriel Conilon Excellence Competition, which takes place annually since 2004 and which, in 2015, completed the 12th edition. This competition is the pioneer in the State and in Brazil for the conilon coffee award regarding quality. The competition presents itself as an important marketing mechanism for the Robusta Coffee quality in Brazil, as well as being an important technology incorporation tool for the production and management of coffee properties (Figure 16).

Figure 16. Brazil Conilon Coffee Symposium and Cooabriel Conilon Excellence Competition, São Gabriel da Palha/ES, 2012.

Photo: Communication Advisory/Seag.

International Conference of *Coffea canephora*

Under the coordination of the Government of the State of Espírito Santo, through Incaper and Embrapa, in partnership with 40 other institutions, Vitória/ES hosted from June 11 to 15, 2012, the largest and most complete scientific technical event in the conilon coffee area, the *International Conference of Coffea canephora*, presenting as a central theme the One Hundred Years of History and Evolution of Conilon in the State of Espírito Santo - Brazil.

Technologies, development and perspectives for the conilon coffee production chain were subjects of panels, lectures and debates throughout the event, which was the highlight of the celebrations of the conilon centenary in Capixaba lands. There were 17 countries participating, with 1.2 thousand participants attending lectures, debate panels, conferences, tastings and visits to plantations that count on technologies and lie in the countryside of the State.

The conference meant a recognition of all the work developed over decades, which made Espírito Santo a world reference in generation and socialization of knowledge and technologies for conilon coffee. For the future, it pointed to a new path to be pursued: the ceaseless search for quality as a way to increase the participation of this coffee species in the market and to differentiate the conilon in the selective group of the best robustas in the world (Figure 17).

Figure 17. International Conference of *Coffea canephora*, Vitória/ES, 2012.

4 SOME GENERATION, DIFFUSION AND TRANSFER OF TECHNOLOGY RESULTS

The effort to generate, diffuse and transfer technologies for conilon culture in the State of Espírito Santo has built a very important scientific and technological base in order to provide coffee growers with technical security of production.

In the generation field, there are more than 50 technologies, led by 15 superior clonal cultivars, in addition to others related to nutrition, irrigation, pruning, harvesting and post-harvesting methods, among others. In total, there are more than 4 thousand knowledge generated as, for example, the selection and evaluation of 2 thousand clones that are contained in the Banco Ativo de Germoplasma - BAG (Germplasm Active Bank) with 500 accesses.

The technologies generated, coupled with the methodological apparatus structured in Espírito Santo for its effective use by coffee growers, have resulted in a fantastic increase of technical and economic indicators, at a speed not perceived in other coffee farms in the world as a whole.

When referring to the three main technical indices of the conilon coffee area of Espírito Santo, as size, production and productivity, it is possible to measure and verify that all the effort employed in the generation and transfer of technology was not in vain. In only 21 years, from 1993 to 2014, the area harvested grew only 6%, from 267 thousand to 283.1 thousand ha, while production jumped from 2.4 million to 9.95 million bags, or 315%. The main factor of this evolution was the growth of 290% in productivity, which increased from 9 to 35.14 bags/ha, proving the effective use of the knowledge generated by the Capixaba coffee growers (Figure 18).

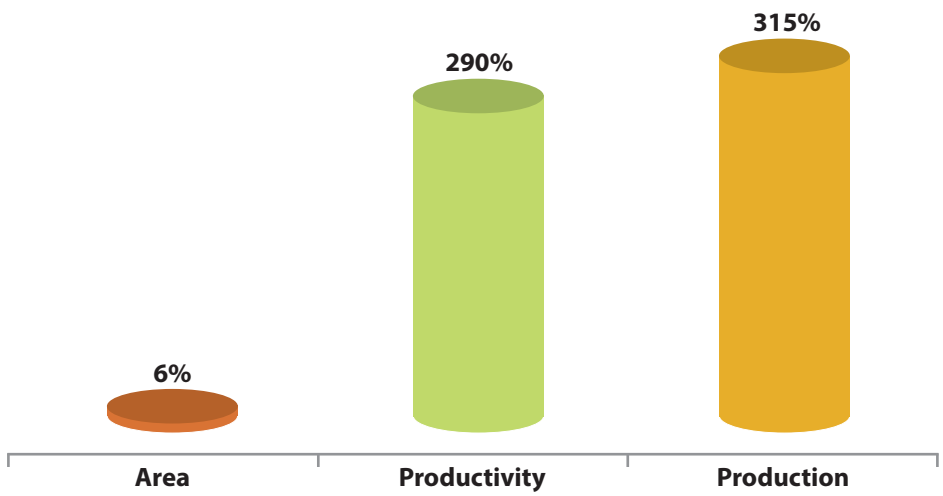

Figure 18. Percentage of area growth, productivity and conilon coffee production in Espírito Santo from 1993 to 2014.

It is important to emphasize that productivity, the main indicator of technological incorporation, already surpasses the level of 200 bags/ha, both at the experimental level and in more technical crops. Therefore, this amplitude of variation between the potential and the average productivity verified tends in Espírito Santo to be reduced from the crops renewal in

new technological bases.

Increasing productivity is a key factor in reducing unit production costs, increasing the gross and net income of coffee growers and promoting greater efficiency in the other links of the production chain. In 2014, the conilon coffee production gross value reached R$ 2.36 billion, which represented 29% of the Gross Value of Agricultural Production.

Thus, increased production, through increased productivity, increases income and ensures socioeconomic stability, which is strategic for the countryside development in the state of Espírito Santo, making coffee cultivation the most important agricultural activity for the rural area of this State.

Considering the stock of existing technologies, the constant generation of new knowledge and the efficient of diffusion and technologies transfer process structured in Espírito Santo, it can be estimated that the scenario for conilon coffee in the State for the next ten years is with a production between 16 to 20 million bags, average productivity over 55 proces. bags/ha and practically stabilized planted area. This view is corroborated by most experts in the segment.

5 FINAL CONSIDERATIONS

The mobilization of local government of São Gabriel da Palha, located in the northwestern region of the State of Espírito Santo left a valuable legacy in the constant search for conilon coffee production excellence and, more than that, gave more confidence and security in the consolidation of its productive chain.

Perseverance was the most striking feature in that economic and social crisis moment, produced by the Federal Government's Coffee Eradication Program, from 1963 to 1966, and the non-inclusion of regions below 400 m altitude in the coffee crops Renewal Plan, released in 1969. Therefore, this product saga and the embryo of the technologies transfer actions have as landmark the year of 1970.

The great positive balance of this process was the creation of an articulation and local decisions network that provided conilon coffee growing an endogenous growth to the State of Espírito Santo, being very little dependent on federal decisions.

Although the social and economic indicators of the activity have greatly evolved over the years, it is necessary to clarify that there is a long path to go, given that both the process of knowledge generation and the search for overcoming new bottlenecks and challenges are continuous.

It should be remembered that the current average productivity of Espírito Santo that is about 35 bags/ha still has a lot to grow, considering that new cultivars have been launched recently, such as Diamante, Jequitibá and Centenária, as well as a large stock of other knowledge and technologies that are still in the process of being adopted by coffee growers.

The implantation of more than 200 clonal gardens, strategically distributed in the State offering superior genetic materials, which present results ranging from 50 to 70 million conilon coffee seedlings every year, is also a guarantee of the area renovation and productivity increase.

Special attention should be paid to the projects that the State Government, through Incaper, is developing in the southern region of the State, such as Correct Limestone and Renew Conilon South. In the medium term, it is expected that there will be an improvement in economic performance, with an increase in the technological level employed in the crop, which will comply with the goal of reducing regional inequalities and will also contribute to the increase in the average state productivity.

It should be pointed out that, besides traditional bases of research and technologies transfer located in the north, in Marilândia and Sooretama for more than a decade, the Experimental Farm of Bananal do Norte in Cachoeiro, in the south of the State is also consolidated as one more support point to this region coffee growers.

The evolution of the articulations between the public and private sectors, as well as the institutionalization and professionalization of these relations that aim at the development and promotion of the product, is now completely visible. This has been the main facilitating strategy for the innovation process, which promotes the improvement of the information level and contributes to a cooperative environment. This institutional interaction has been the key to advancing the diffusion and technology transfer work for conilon coffee.

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