SUSTAINABLE GOOD AGRICULTURE PRACTICES MANUAL,

To improve yields of organic coffee and control coffee rust

Créditos

Revisión:

Jefferson Shriver	Catholic Relief Services
Jimmy Largaespada	Catholic Relief Services
Martha Estela Gutiérrez	CAFENICA, Matagalpa, Nicaragua

Coordinación Técnica:

Ing. Henry Mendoza Vidaurre	CAFENICA, Matagalpa, Nicaragua

Revisión técnica:

Ing. Albín Ochoa M	UCA UCPCO, Madriz - Nicaragua
Ing. Heber Magdiel Montenegro	UCA UCPCO, Madriz - Nicaragua
Ing. Ana Rosa Romero	Coop. La Unión, UCOSEMUN, Wiwili, Nueva Segovia - Nicaragua
Ing. Félix H. Medina V.	Coop. 20 de Abril, UCOSEMUN, Quilali, Nueva Segovia - Nicaragua
Ing. Bernabé Zelaya P.	Coop. Flor de Café, UCOSEMUN Murra, Nueva Segovia - Nicaragua
Ing. Armando Misael Rivas	PRODECOOP, Estelí - Nicaragua
Ing. Manuel Quinteros M	PRODECOOP, Estelí - Nicaragua
Ing. Carlos Tardencilla C .	CECOCAFEN, Matagalpa - Nicaragua
Ing. Pedro Pablo Velásquez	UCA Tierra Nueva, Boaco - Nicaragua

Fotografias: Henry Mendoza Vidaurre, Manuel Fandiño.

Diseño y diagramación: Ariel Flores

Agradecimientos

Al personal técnico de las Organizaciones Cooperativas, por la información y sus experiencias expresadas en el documento, a los productores visitados en sus fincas por su atención y el compartir sus conocimientos-experiencias prácticas, sobre el proceso de mejoramiento productivo y de la calidad, así como las estrategias de manejo y control de la roya, en la producción orgánica de Café.

A Jaime Picado Zamora y Jaime Ricardo Picado, de la Empresa Certificadora Biolatina, por su revisión en la parte de reglamentos y normas para la producción orgánica y Agro-Ecológica.

Contenido

Presentation

Cuando uno hace una mirada de los paisajes de Latinoamérica y el Caribe, la observación más común es que donde hay asentamientos humanos, no hay bosque. El café representa una excepción a esta regla: a menudo donde existen cafetales, existen árboles que forman capas de sombra que asimilan un bosque. Hoy día el café aun representa un rubro agrícola de sostenibilidad ambiental por su afán a la sombra y relativamente pocos requerimientos de insumos. Los mercados ecológicos de café abundan, y muchos productores han respondido a estos nichos de mercado donde se premia la agricultura sostenible. Cuando existen cafetales bajo sistemas de producción sostenible, comunidades enteras benefician de un micro-clima libre de plaguicidas, donde hay protección de fuentes de agua y conservación de suelos, y donde se encuentra santuarios para la fauna y la biodiversidad.

Sin embargo, hoy en día la producción sostenible de café enfrenta una crisis de grandes proporciones. La roya del café ha devastado comunidades enteras de café, defoliando plantaciones como nunca antes visto. La respuesta convencional a la roya es la aplicación a mayor cantidad de agro-químicos. Los que practican la agricultura sostenible aparentemente son indefensos ante semejante amenaza, sin herramientas para combatir la roya.

Por otro lado, la producción orgánica es señalada de no ser una opción viable, debido a que muchos productores reportan bajos rendimientos que inciden negativamente en la rentabilidad del café. Los premios otorgados en precio no compensan por una baja producción.

Frente a estas dos problemáticas, el sector de café ecológico requiere herramientas y lineamientos al alcance del productor, al técnico, y a los tomadores de decisión en el sector público y privado. Este manual fue elaborado con este propósito. El documento es un esfuerzo en conjunto entre tres actores que abordan la problemática desde distintos ámbitos: la cooperación internacional (CRS), gremio de productores (CAFENICA) y una certificadora ecológica (Biolatina) para hacer un aporte para llenar el vacío de información existente sobre estos dos temas en la actualidad.

El manual es una herramienta que pone información práctica en sus manos sobre el manejo ecológico de la roya, como también un sinnúmero de prácticas ecológicas utilizadas en la finca para aumentar la productividad del cafetal. El documento brinda testimonios de experiencias prácticas y exitosas de productores y productoras, recetas de insumos agro-ecológicos listas a probar, consejos técnicos sobre regulación de sombra, cultivos de cobertura de suelo, selección de árboles con mayores atributos de servicios agrícolas, descripciones de variedades de café, y descripción de productos permitidos para la producción orgánica certificada.

Los que patrocinamos este documento sentimos una urgencia para su creación y divulgación, debido a que diario los productores toman decisiones de continuar o no en la producción ecológica del café que seguirá siendo clave para los paisajes rurales de la región. Por ende tenemos versiones electrónicas en Ingles, español, y Frances para bajar de nuestra página web de forma gratuita.

Jefferson Shriver
Catholic Relief Services

CHAPTER 1
Standards for organic coffee production and certification

1.1 What is organic agriculture?

In 1999, the International Federation of Organic Agriculture Movements (IFOAM) defined organic or ecological production as agricultural systems where the production of foods and fibers are environmentally, socially and economically sustainable. These systems consider the fertility of the soil as the key factor for successful production.

Keeping in mind the natural capacity and ability of plants, animals and landscapers, the impetus is to optimize quality in all aspects of agriculture and the environment. Organic agriculture greatly reduces the use of external inputs on farms and eliminates the use of fertilizers, pesticides and other treatments derived from man-made chemicals. It allows the power of nature to work instead, increasing yields and resistance to diseases.

Another suggested definition by the Codex Alimentarius Commission (FAO/WHO 1999) indicates that organic agriculture is a global system of production which promotes healthy agro eco-systems, as well as the biological diversity, cycles and activity of the soil.

1.2 What are the basics of organic agriculture?

The principles of organic agriculture go beyond the prohibition of applying chemical fertilizers. These are based on specific and precise production mechanisms whose purpose is to achieve optimal agro systems meant to be sustainable from a social, ecological and economical point of view.

At a General level, organic agriculture seeks to:

- Improve and maintain natural landscapes and agro-ecosystems
- Avoid overuse and pollution of natural resources
- Minimize the use of energy and depletion of non-renewable resources
- Produce enough healthy and nutritious high-quality food
- Provide adequate returns in a healthy and safe working environment
- Acknowledge indigenous knowledge and traditional agricultural systems

At a Practical level:

- MMaintain and increase soil fertility in the long term
- Improve the biological cycles within a farm, especially the nutrient cycle
- Provide natural nitrogen through intensive use of leguminous plants
- Biological protection of plants based on prevention rather than on curing diseases
- Promotes diversity in types of crops and animals appropriate for the area
- Proper animal husbandry based on the characteristics of each animal
- Prohibition of synthetic chemical fertilizers, pesticides, hormones and other growth regulators
- Prohibition of genetic engineering (transgenic materials) and byproducts
- Prohibition of methods, additives and harmful synthetic ingredients in food processing

Likewise, organic agriculture strengthens sustainability for the entire productive system. Essentially, this entails the successful management of resources in order to satisfy human needs while maintaining and improving the quality of the environment and natural resource conservation.

1.3 What is organic certification?

The certification is a written warranty provided by an independent certification agency which assures that the production process abides by the requirements and norms established by different countries or organizations, complying with the characteristics required in order to access specific markets. (Andersen 2003).

These certification requirements may also take into account environmental aspects (conservation of soils, protection of water, pesticide use, handling of waste material), social aspects (producer's income, worker's rights, safety) or other quality aspects (altitude, characteristics of the region, processing).

Internationally known certification organizations comply with ISO/IEC 17065 Standards. These standards outline very specific norms and standards, whose rigorous compliance guarantee that the certification organizations operate schemes in a competent, consistent and impartial manner, thereby ensuring the recognition of these certifying organizations and the acceptance of their certified products at the national and international level.

The leading authorities within major organic markets (Europe, USA, Canada, Japan) require that organic certification entities comply with ISO/IEC 17065 Standards so that products certified as organic can be recognized and labeled as such in their markets.

1.4 What are the reference norms for organic production?

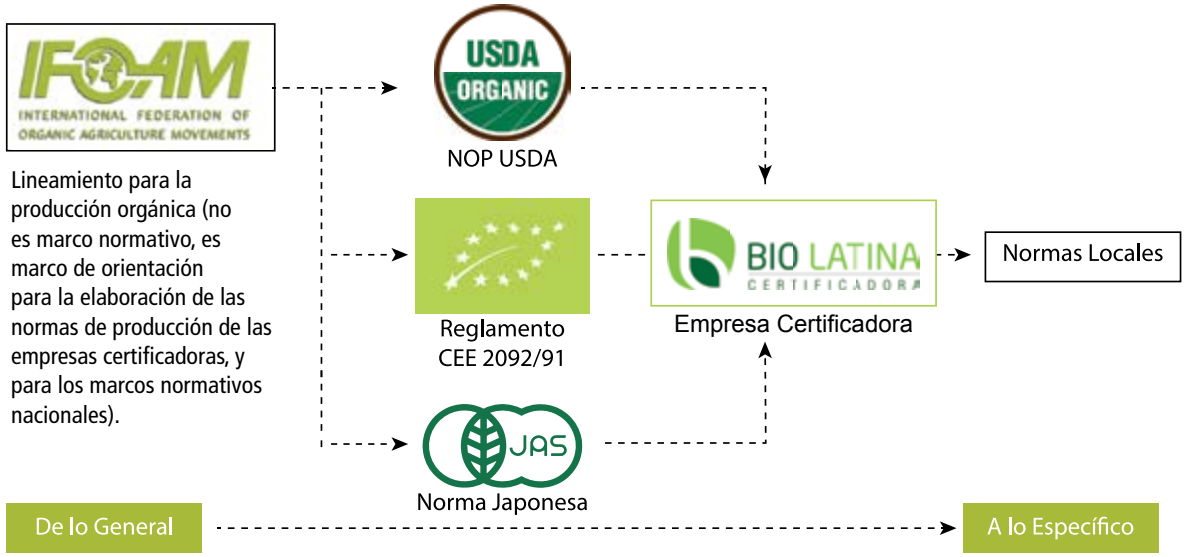
There are two main internationally accepted references - frameworks which serve as guides for organic agriculture in different countries. These are:

Basic Standards for Organic Products, issued by IFOAM in 1980, and the Guide for Producing, Labeling, Processing and Marketing Organically Produced Foods from Codex Alimentarius issued in 1999.

Both references noted above set up a framework for the design and development of national regulations, nevertheless these norms must also consider local regulations for their implementation. In practice, due to commercial regulations between countries, the official regulations regarding organic certification in destination countries are also taken into consideration when creating norms in supplier countries. These references are: EU Regulation EC 834/2007 and EC 889/2008, National Organic Standard (NOS) by USDA in the US markets, and Japanese Agricultural Standards (JAS) for Japan.

It should be noted that the majority of Latin American countries have their own standards for organic (ecological) agriculture. In Nicaragua, since 2003, the Nicaraguan Obligatory Technical Policy (NTON in Spanish, NOTP in English) regulates the certification process, to include the preparation, transportation, storage and marketing of certified organic products in the country.

Figura 1. Escala normativa para la certificación de la producción orgánica



Cabe señalar que la mayoría de los países latinoamericanos tienen ahora normas propias para la agricultura orgánica (ecológica). En Nicaragua a partir del 2003 se cuenta con Normas Técnicas Obligatorias Nicaragüenses (NTON) que regulan la certificación incluyendo la producción, elaboración, transporte, almacenamiento y comercialización de productos orgánicos certificados en el país.

1.5 Why produce and certify organic coffee?

Economic benefit:
For 70% of coffee producers, organic production represents an alternative to the fluctuations in the market price of conventional coffee. With certified organic coffee, producers have been able to obtain better and more stable prices.

Social and environmental improvement:
In addition to the economic benefits, organic coffee production provides 67% of farmers with social and environmental improvements, as 8% of these no longer need to find work elsewhere, 17% were able to obtain other resources for their family and 42% mentioned avoiding toxic risk to their family members and communities as they no longer use agrochemicals. An additional benefit is the reduction in waste contaminants to the soil and water that is used.

The application of pesticides not only kills harmful insects, but also kills beneficial ones. Many soil microorganisms that are important for the recycling of nutrients are lost, causing a greater need for fertilizer. Moreover, when pesticides are used, insects develop resistance to these over time, requiring the application of increasingly stronger doses and larger quantities of pesticides.

When producers apply agrochemicals, residues persist in the soil for years and pollute water sources and producers themselves. This in turn may cause members of the surrounding communities to develop cancer, problems with the nervous system or brain, infertility in men, or natal problems in pregnant women.

The implementation of organic coffee production avoids the aforementioned problems.

Chapter 2
Good Agriculture Practices for Organic Coffee Production

2.1 Environmental conditions for growing organic coffee

Coffee requires a combination of specific climatic factors such as elevation (meters above sea level), temperature, precipitation, cloudiness, sunshine, relative humidity and wind speed for its growth and production.

For coffee to grow and reach optimal levels of production, it has to be established in areas where all soil, climate and environmental factors are in place. In addition, good agronomic crop management processes must be practiced throughout the production cycle.

Elevation or altitude (meters above sea level)

The altitude required for the cultivation of coffee depends on each variety, but it can be grown at altitudes ranging from 400-2000 meters above sea level. However, the ideal altitude that provides best conditions for coffee production is between 800 to 1,200 meters above sea level.

Precipitation

Coffee grows best in areas with 1600-1800 mm of precipitation per year, in which there is also a dry season of 3-4 months to promote flowering and fruiting.

Although coffee has some drought tolerance, production declines considerably when precipitation is below 1000 mm per year. Moreover, when rainfall exceeds 1800 mm per year, increased illness and loss of soil nutrients affect quality. Critical times such as transplanting, flowering and fruiting require more water. Preferably, the rainfall should be distributed throughout the year, as this will provide higher levels of quality and quantity.

Temperature

Coffee plants prefer an annual average temperature between 18°-23° C. Other factors which determine the optimal temperature range are levels of solar radiation, altitude, ground texture, amongst others. If coffee is grown above an average temperatures of 24° C there tends to be an increase in vegetative growth, which limits flowering and fruit filling.

Soil

The best soils for growing coffee are loamy soils (loose soils with sufficient aeration and good drainage), which are also deep and fertile, to allow for coffee roots to penetrate and grow easily. These soils are generally black, brown, red or yellow in color. Coffee requires high quality soils. The ideal soil has a mix of clay and sand with a pore space of 60 percent and a top layer of organic matter greater than 50 cm deep. A slightly acidic soil, between 6 and 6.5 pH is preferred, however coffee can grow in soil with a 3.1 pH level.

Although high altitude coffee is best in quality, care should be taken to not establish plantations on slopes greater than 45 percent. On terrain where the slope is greater than 45%, intense soil conservation interventions are highly recommended to prevent erosion.

2.2 Varieties of Coffee

Coffee varieties used by farmers and producers in organic production are best grown under shade. The main varieties belong to the Arabica species (Coffea arabica L), and include Caturra, Bourbon, Catuaí (yellow and red), Maragogype, Maracaturra and Catimor. For establishing any of these varieties, one must ensure appropriate ecological conditions (altitude, rainfall, temperature, relative humidity, shade, soil fertility, type of management system to implement, etc.).

The Caturra variety is grown by the majority of producers, mainly because of its adaptability to semi-intensive farm management and minimal agricultural practices (low fertilization needs, ease of tissue handling, shade regulation and plant management), good yields and stable productivity, as well as for its organoleptic characteristics (low caffeine, round berries, mild to slightly tart flavors, chocolate-colored, smooth and intense perfume) and for the quality and value received from the domestic and international market. Caturra is followed by the Bourbon variety, with approximately 25% of cooperative members growing this variety due to its tolerance to pests and diseases and low fertility needs. This variety is grown in combination with other varieties.

The main varieties grown by small-holder farmers and producers are described below.

Caturra

Characteristics

- Originally from Brazil
- Low growing plant
- Short branches, thick trunk, abundant side branches that give it a lush vigorous appearance.
- New leaves are pale green, mature leaves are deep green
- Develops a good root system
- Grows well in high altitude areas, 900-1,200 meters above sea level
- Begins production early
- Susceptible to coffee rust
- The color of the ripe fruit is wine-red and yellow, has round berries.

Organoleptic Characteristics

- Low in caffeine, mild to slightly tart, chocolate-colored, smooth taste and intense fragrance, floral aroma. Very good cup quality.

Paca

Characteristics

- Originally from El Salvador
- It is very similar to caturra, though with more foliage.
- Grows well in low altitudes between 450-700 meters and at intermediate altitude between 700-1000 meters, where it produces better and earlier growth.
- At altitudes above 1,200 meters, growth is slower and production is delayed
- Good drought resistance
- New leaves tend to have a bronze shade, but not as reddish as catimor. In nursery stage, leaves are thick and wide..

Organoleptic Characteristics

- It produces a good quality coffee. Some of the most common features are sweet chocolaty scent, acidity and medium to low body, but with better body dominance.

Catuaí

Characteristics

- Originally from Brazil, cross between Caturra and Mundo Novo.
- Produces greater yields than Caturra.
- Best at altitudes between 900-1400 meters
- It has low tolerance to diseases and poor soil fertility
- When ripe, fruits are yellow, although some are wine-red.

Organoleptic Characteristics

- Fragrance and flavor is chocolaty, acidity and body are medium. This variety is less intense in these characteristics and they can also vary.

Catimor

Characteristics

- Recently introduced variety
- Resistant to coffee rust, but susceptible to leaf spot (Mycena Citricolor).
- High productive capacity
- Has the ability to produce a large number of branches
- New leaves are reddish brown, although there are new varieties of intense green
- It is best suited for medium altitude, between 700-1000 meters.
- Demands a lot of light, so grown with less shade.

Organoleptic Characteristics

- The cup quality is low, with varying characteristics. There is little consistency in flavors, although generally has a fragrant and sweet aroma. Not all samples develop equally; sometimes cups have certain fruit tones and harsh aftertaste, making it less desirable in the specialties market.

Borbón o Bourbon

Characteristics

- Can reach 4 meters in height
- The distances between branches and internodes are greater than Caturra
- Round and shiny leaves
- The color of new sprouts are green
- Small round berries
- Well adapted to high altitude and recommended for above 1000 meters
- Sensitive to wind
- Early maturing berries, which are burgundy red but can be yellow-orange.
- **Organoleptic Characteristics**
- Produces a good quality coffee, some of the most common features found are fragrant citrus and floral aroma, chocolaty to fruity flavor, has a balanced and clean cup, with good flavor, creamy body and bright acidity.

Maragogype

Characteristics

- Originally from Brazil, named after a municipality.
- Can reach 6 meters in height
- The distance between branches and nodes is greater than Bourbon variety
- It is well adapted to high altitudes and recommended for above 1000 meters
- Leaves are long and large
- Berries are large and oblong in shape

Characteristics (Maragogipe)

- The quality obtained from this variety is superior with intense acidity but less body. Shows some imbalance, but generally a good cup and is highly prized for blending with milder coffees.

Maracaturra

Characteristics

- Is a cross between maragogype and caturra
- Well adapted to high altitude and recommended for higher than 1000 meters
- Plants are of medium size with large beans, although over time berries tend to become more like caturra.

2.3 Planting Material

SELECTION OF SEEDS

Based on a good selection of planting material, producers can expect the productivity and yields they require.

Most producers choose their own seeds each year to establish new plants and / or to replant. The selected seeds come from mother plants with the following characteristics:

- Pest and disease free
- Aged between 7-12 years
- Well developed and uniform bean size
- Plantation must be at optimum productivity stage
- The plant is well loaded with fruit
- The plant is vigorous
- Plants with recommended agro-ecological conditions

Other activities to ensure quality seed selection

Selection

Select only healthy beans that have reached full maturity and that are located in the middle part of the tree (on primary or secondary branches) and in the middle section of each branch.

Flotation

Once harvested, producers must place selected beans in water and eliminate those which float, as these are not productive. This is a first step in selecting which seeds to use.

Pulping

Subsequently, producers de-pulp the selected seeds. It is recommended that this activity be done by hand to avoid damage to the seeds.

Fermentation

This activity takes place in concrete tanks, wooden crates or jute bags. The recommended fermentation time is 8-12 hours in order to not affect the germination of seeds, but can be extended for up to 18 hours in areas with lower temperatures.

Washing and drying

After the fermentation process, thoroughly wash seeds in clean water. Deformed seeds are eliminated, as well as small, misshapen, or those with insect bites. Only the largest and uniform seeds are selected for drying, which is done in small wooden boxes and under some shade until seeds have dried to 18-20% moisture.

Storage

The seeds are stored in bags, baskets or in the same wooden boxes used for drying; this allows for some air flow. They are then stored in a cool place until ready for planting. With this simple process, there is less damage to seeds and germination levels are maintained. As a result of these practices, producers are able to reduce costs in the nursery, obtain vigorous and pest-resistant plants, as well as being appropriate for local conditions.

If producers wish to use an improved variety for establishing new plantations, it is advisable to acquire these through reliable distribution networks, such as research centers, coffee associations, institutions or universities that provide certified seed.

2.4 Establishment and management of seedbed

To establish a seedbed, the following steps are recommended:

Constructing the seed bed

Germination banks require fertile soil mixed with sifted and washed river sand, from which all stones, roots and other foreign material that may affect the development of the seedlings have been removed. The recommended proportions are 75% sand and 25% soil. The use of sand provides a structure for good root growth and ensures proper root development prior to transplanting.

Disinfecting the soil

It is recommended to disinfect the soil to prevent fungal diseases, for which there are different methods:

- Direct solar heat. This involves covering the soil with plastic and leaving in the sun for 8 hours, in order for the soil to reach a temperature of 70 degrees Celsius. The intense heat will kill most pathogenic organisms. Once the plastic is removed and the temperature of the soil has returned to normal, it can be used for planting.
- Boiling water. This method consists of pouring 16-20 liters of boiling water per square meter of soil. The recommendation is then to loosen the soil and wait 4 days as the gases produced from the decomposition of the dead micro-organisms evaporate. At this point, the soil is ready for planting.
- Application of Bordeaux mixture. In this method, a chemical mixture consisting of 1 ounce of copper and 2 ounces of lime, diluted in 16 liters of water, is poured onto each square meter of soil. After 2-3 days, the soil is ready for use.

When planting the seeds, the soil should be moist but not wet, regardless of which disinfection procedure was used. The site where the seedbed is located should have enough water and be easily accessible.

Size of the seedbed

The seedbeds should be 1 meter wide, 20 centimeters high and whatever length is desired by the producer. One meter in length is generally enough for planting one pound of seeds, which generally produces 1000 seedlings. However, the specific number of seedlings will depend on the variety of coffee. When more than one germination bank is built, there should be 40 to 50 centimeters between each one, to allow for sufficient space to walk between.

• Other
The perimeter of the seedbed should be protected to deter the entrance of animals.

The seedbed should also be protected from direct sunlight. In most cases, producers build temporary shade shelters, ranging between 70 centimeters to one meter in height, which allow for 50% shade. This shelter can be built with clean jute bags, long-stemmed grasses, palm branches, banana leaves or other easily-available natural materials. Producers should avoid using coffee branches and leaves as these can be a source of disease

Planting the seeds

Prior to planting, the seedbeds should be well watered and prepared. Using a rake or stick, the seedbed should be leveled and furrows of 1.5 - 2 cm deep should be made, leaving 5-7 cm between each furrow.

The seeds are then deposited into the furrows, evenly spaced together yet preventing them from being clumped together too much.
The seeds are then pressed slightly into the ground and covered with disinfected soil.

After planting, the seedbeds should be covered with a layer of dry chopped (seedless) grass, Spanish Moss or clean used jute bags. This is done to ensure that seeds are not uncovered when watered

Seedbed management
• Care should be taken each day when watering the seedbed. This should be done in the early morning hours, using a watering can to distribute the water evenly.

Producers must constantly monitor the seedbed to identify problems and take corrective action in a timely manner.

• When the seeds begin to sprout, which is between 35 and 45 days after planting, the protective covering should be removed.

• If plants are affected by damping-off disease or other diseases, the producer must remove and destroy the affected seedlings. As a preventative measure, an application of Bordeaux, consisting of 3 parts lime and 1 part copper sulfate diluted in 4 gallons of water, should be applied to the seedbed.

In addition, shade and moisture levels in the seedbed should be monitored and regulated.

Transplanting the seedlings
The transplanting of seedlings should take place between 60 and 90 days after planting. This task should be done with the greatest possible care.

To easily remove the seedlings and not harm the roots, the seedbed should be thoroughly watered first.

Only the healthiest and strongest plants with well-formed roots should be selected for transplanting.

2.5 Establishment of an organic coffee nursery

The procedure for establishing nurseries is as follows:

1.Where to locate the nursery

The location of the nursery should be easily accessible, close to where the coffee will be planted, relatively flat, with availability of water and where sunlight can be regulated.

If there is no available natural shade, one can build temporary shade using long-stemmed grasses, banana leaves, palm branches or other natural material, in order to protect the nursery from excessive sun and wind.

The area must be relatively flat, in order to prevent deformed or damaged root systems while the coffee plants are growing after being transplanted from the seedbed.

Nursery Design

To ensure quality, plants must be placed in rows or banks of 1 meter in width and up to the length required for the number of plants a producer will plant.

Rows or banks can be formed with 3-6 rows of bagged seedlings, leaving a space of at least 1 inch between each row. The space between banks should not be less than 50 centimeters, as this is the necessary space required to assist in the management of the plants.

.

Seedlings should be planted in polyethylene bags for ease of transport when travelling long distances or when access to the final plantation site is difficult

Preparing the soil for filling bags

To prepare the soil needed for filling the polyethylene bags, loosen 20 cm of topsoil which has not grown coffee previously and is rich in organic matter. This soil has to be loose, without stones, roots and all other foreign material. As a suggested step, the soil can be sifted through a sieve to ensure uniformity in particle size and uniformity.

The soil should be mixed with coffee pulp, cow manure, vermicompost, bokashi, bat guano, compost, lime or ash in order to disinfect it. These additives also assist in preventing plant loss and promote vigorous, healthy plants which are resistant to coffee rust, pests and other diseases, but also in increasing productivity potential.

Timing for nursery preparation

Nurseries should be prepared no later than the beginning of March to April of each year. The coffee seedlings should be placed in 6x8 inch polyethylene bags

The recommended final transplanting should be around 4-5 months to avoid excessive root growth in the bags and / or require their pruning.

To transplant, coffee plants must have 4-5 pairs of leaves. (Two photos of plants ready to transplant).

In areas where irrigation is available, the nursery can be established in February, ensuring that the plants are ready for final planting in June.

Transplanting the coffee seedlings to bags

For transplanting the seedlings to polyethylene bags, the following recommendations should be taken into consideration:

- The seedlings should be transplanted on cool days, first thing in the morning or later in the afternoon, ensuring that the soil in the bags is wet.
- The depth of the hole must be greater than the length of the root of the seedling.
- The coffee seedling should be planted with the root in a straight downwards direction, as when it was still growing in the seedbed.
- Firmly press down on the soil around the base of the plant with the planting stick to expel any air pockets around the roots.
- At the time of transplanting, apply 5g of mycorrhiza to each plant, directly to the roots of the seedlings.
- Once the plants are transplanted, they must be watered thoroughly.

While the plants are in the nursery, it is essential to water the plants every day during the dry season and as needed during the rainy season.

Nursery management

To help plants grow better and resist attacks by disease, it is recommended to weed for unwanted plants, water regularly, apply foliar sprays made from livestock manure, honey water mixed with minerals, vermicompost and natural fertilizers strengthened with minerals (Zn, B, Mg, Mn, or K) or rock flours of different colors.

Producers can also apply other mineral sprays based on sulpho-calcium, ash, Visoca or Bordeaux mixtures depending on the type and incidence of disease. (See Chapter on Pests and Diseases).

Care must be taken to not exceed the appropriate dosage when preparing these sprays, so as to not poison the young coffee plants.

As the plants grow, regulating shade begins at two months from transplanting, at which point sunlight is gradually allowed to enter, until completely removing all shade.

This ensures that plants develop and adapt to local conditions upon final transplanting.

Keep in mind that on certified organic farms, the seeds and vegetative materials used must be organically produced. Only if these are unavailable in the market, can non-organic seeds that have been treated with prohibited products be used, as long as permission from an accredited certifier, such as BIO LATINA, is received.

2.6 Establishment and management of a Coffee Plantation

Before establishing a coffee plantation, it is wise to choose a particular production system adapted to the ecological, economic, material and human resources available, as well as being aware of the effects of global climate change on the production, presence of pests and diseases, while keeping in mind that the goal is production, quality and profitability.

To decide where to plant a new coffee plantation, producers must take the following points into consideration

Type of soil
The best type of soil should be loose, not too stony, composed of organic matter and fertile, with a slope no greater than 40%.

It is recommended that a soil and microbiological analysis be conducted to determine the level of fertility and nutrient needs prior to planting the coffee. This exercise should be finished prior to planting and in order to make a plan for incorporating and composting microorganisms found in organic fertilizers and bio-fertilizers.

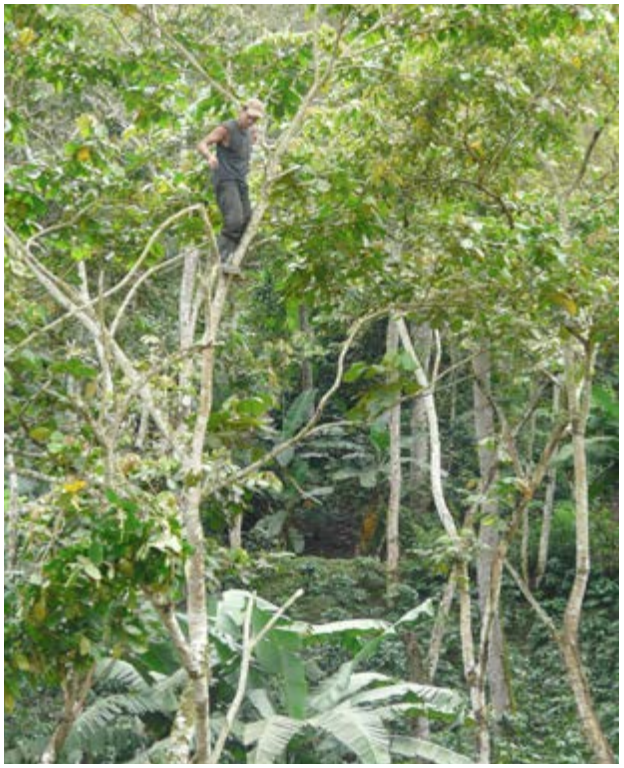
Existing shade
Generally, sites chosen by producers already have some trees growing on them. In these cases, trees should be selectively pruned or managed, leaving those with desirable shade characteristics and eliminating those that impair the development of coffee

If the site has no shade prior to transplanting, there are two options:

1)Draw the layout of the plantation in April and, once the rains start, plant Gandul, Tephrosia and Crotalaria in the coffee rows for temporary shade and to serve as live barriers. Between the rows of coffee, plant canavalia as a cover crop, for weed control and moisture retention. In the same year, plant permanent shade trees such as guavas, bucaros and other species throughout the plantation.

2)A year in advance to establishing the plantation, prepare the site by planting temporary shade (banana, plantains or fig trees), while the permanent shade of guava, bucaro or other shade species develop.

The stalks and branches which are a product of the pruning should be collected and piled-up between coffee rows, to serve as dead barriers and to increase organic matter in the soil



Slope of the land
Ideally, coffee should not be planted on slopes greater than 40% without the implementation of soil and water conservation practices. Most plantations of smallholder coffee producers are on slopes greater than 40%, which require more intensive conservation methods to reduce the effects of soil erosion, maintain soil fertility and improve the structure and composition of these soils.

Varieties
To renew and establish new plantations, producers must select those varieties adapted to each climatic zone, but which also produce good yields and high quality coffee, are disease tolerant, particularly to coffee rust, and can confront the effects of climate change. Fearing coffee rust, many farmers have planted Catimor varieties, but they are also planting traditional Arabic varieties (caturra, catuai, paca) which, with a good selection of seeds, nursery management, adequate management of the soil and appropriate usage of foliar sprays, can be productive and tolerant to Coffee Rust.

Plant density
Plant density is the number of coffee plants, required for an area between rows and plants. These distances determine the number of plants to be planted per Manzana.

Plant density is established taking into account these factors:

- The slope of the land and level of fertility
- The altitude above sea level
- The variety of coffee to be cultivated
- The system for pruning
- The planting system
- The shade trees to be cultivated and other crops grown in the plantation
- Plant management practices and fertilization plan
- Presence of diseases and pests

For organic coffee growing, densities of 2,500 to 3,333 plants per Manzana are recommended (equivalent to 2x2 yards and 2x1.5 yards respectively). These densities ensure sustained production levels and good levels of fertilization. In addition, these densities create an environment which is less prone to coffee rust and other diseases.

Observations made on plantations in the same region where healthy and lush coffee plants are growing can give guidance on recommended plant densities. Ideally, the distance between plants allows for branches growing at the lower part of the plants to not interfere with each other (only 5 to 10 cm) nor provide shade for each other.

The use of contour lines and contour planning

In renewing or planting new areas, an essential task is to draw appropriate rows for the coffee plants, in which soil and water conservation techniques are implemented. A very effective practice is planting the young coffee on contour lines, which along with the use of live barriers, hedges and trees for shade ensures consistent ground cover throughout the year.

The contour lines or outlines for contour planting are established as points at the same height, so that rain water, deterred by the contour line, does not erode the soil but rather infiltrates into the soil.

How are contour lines established?

To trace contour lines on the ground, the necessary tools are a device similar to an easel or tripod, also called the "A" device, a tape measure, a notebook and a pencil.

To know where to locate the main rows for dead and live barriers the first step is to measure the percentage of the slope, this is the inclination of the slope expressed as a percentage.

How to calculate the percentage of slope?

On flat terrain, the slope is 0%, but slopes vary depending on the inclination of the irregular terrain.

The steeper the slope, the closer the barriers must be to each other. The first thing to measure is the slope on each plot or parcel where coffee is to be grown.

To measure slope, the "A" device is used as follows:

1. Medimos el desnivel en cinco puntos

We measure the slope at five points on the plot, as there are few plots with an even slope throughout the entire plot. The average of these five points is then calculated.

Measure the five points of the plot as follows:

a. The "A" device is placed on the hillside with one leg pointing towards the bottom of the field. This implies that one of the legs will be in the air.

b. The distance between the ground and the tip of the leg which is in the air is measured.

c. This is repeated on five different parts of the

A practical example

For example, Don Juan took five measurements on his plot with the "A" device and the distance between the tip of the leg of the "A" unit that was in the air and the ground directly below gave the following five results:

34cm, 18 cm, 20 cm, 22 cm and 29 cm

- the addition of these five measurements gave a total sum of 123 cm
- 123 divided by 5 gives 24.6
- 24.6 divided by 2 gives 12.3, which means the average slope of the plot is 12.3%

With that percentage, the chart below is used to determine distances:

Distance between live or dead barriers

Slope of the land	Distance in meters	Distance in yards	Number of rows of coffee
5%	20	24	12
10%	15	18	9
15%	12	16	8
20%	9.5	12	6
25%	7.2	10	5
30%	6	8	4
35%	5.5	6	3
40%	5	6	3

As the terrain has a 12.3% slope, barriers need to be established 13.5 meters apart from each other.

How to draw contour lines

To trace the contour lines, a spot in the middle of the plot is selected and a stake is driven into the ground. From that central location, a contour line is drawn extending to the right and left, with stakes driven into the ground until reaching the edge of the plantation. This line is known as the mainline or mother line.

On the main line, measurements are made with stakes to mark the spot where each plant will be planted.

For this measurement, a leg of the "A" device is placed next to the first stake and the second leg of the "A" device is moved until it touches the ground, ensuring that the plumb line is level at the center of the device.

At this point another stake is set in the ground and the process is repeated to measure and trace the contour line.

When all curves have been traced on the plot, stakes can be adjusted slightly either downward or upward to form a uniform contour curve.

With a uniform contour line, the distance between coffee plants is measured and stakes are then placed where every coffee tree will be planted.

To trace the rows where coffee will be planted uphill from the mainline, two sticks of two yards in length are put alongside each stake of the main line to start the second row where the coffee will be planted.

Once all the stakes are set on the second row, these are adjusted accordingly to form a uniform contour line. For the second row, it is not necessary to measure the distance between plants again, as the tool used to dig holes can mark where each coffee plant will be located. At this point, the stakes only serve as a guide for the contour line.

Forma de conservar el suelo y su fertilidad
Construyamos un sistema arreglado

Digging the holes and spacing arrangements

The holes where the coffee is to be planted, if in soils with good fertility, should be 25 cm wide and 25 cm deep. For soils with low fertility, a clayish texture and low water infiltration capacity, the holes should be 30 cm wide and 30 cm deep. The recommendation is to fill these holes with 4 extra pounds of organic fertilizer, which could be compost, Bokashi or vermicompost, mixed with black fertile soil extracted from the hole itself and/or collected from nearby. This will allow plant roots to spread easily and absorb the surrounding nutrients ensuring rapid initial growth.

Transplantation and planting times

It is recommended to dig the holes a month before transplanting in order to disinfect the soil with an application of 2 ounces of agricultural lime or 4 ounces of ash per hole.

The planting must coincide with the beginning of the rains. This allows for stronger plant root attachment in the first year and resistance to stress during the dry season. With the effects of climate change in 2014, higher levels of moisture were lost in soils.

2.7 Establishment and Management of Shade in Coffee Plantation

The use of shade regulates the amount of light, aeration and heat that the coffee plant receives.

The regulated use of shade also increases leaf surface and their chlorophyll contents.

However, excessive shade lengthens the stems and fruit bearing branches or bandolas, thereby increases the length of internodes per branch.

Shade management must be done very carefully, in order to mitigate the effects of climate variability in coffee plantations.

Diverse types of shade are better than uniform shade, requiring that a variety of trees be planted, which also ensures a greater diversity of insects. These contribute to the biological control of harmful insects such as the coffee berry borer. Some species of shade trees are grown in agroforestry systems as well, which represent a source of food for consumption and sale.

Coffee grows best under light shade or regulated shade. Excessive shade is not beneficial for good plantation management nor is excessive sunlight. Shade also plays an important role in maintaining a microclimate inside the plantation, as this can reduce average temperatures by 2-3 degrees Celsius. In plantations where good shade management is practiced, there are also conditions for disease and pest control. Faced with the need to adapt to climate change, the use of shade plays a very important role as it protects the coffee from direct solar radiation and retains humidity in extreme dry periods.

Temporary shade

In order to use temporary shade appropriately, especially in areas where there is no native natural vegetation or where all the vegetation cover has been removed, fast-growing species should be planted to temporarily provide shade for the coffee, while permanent shade trees are growing

Among the plants that can be used for temporary shade are:
For low altitude areas, leguminous plans such as pigeon pea and Crotolaria can be planted. For high elevation areas, Tephrosia (Tephrosia sp) and Crotolaria (Crotolaria anagiroides) can be planted in between the rows of coffee, planting three seeds per hole that are two yards apart. Fig trees and a variety of Musaceas (bananas and plantains) can be planted, but these absorb 20 times more nutrients than coffee, creating competition for required nutrients.

If bananas or plantains are used as temporary shade, these should be planted a year prior to planting the coffee. The recommended spacing for these varieties can be 4x6, 5x6 and 6x6 meters or yards. They should be planted in the middle of the coffee rows in order to avoid competition for water and nutrients.

Temporary shade trees should be pruned every two months, which besides providing a source of organic matter for incorporation into the soil, also promote vigorous regrowth.

Temporary shade trees should be fertilized as well, in order to accelerate their development, along with the coffee

Permanent shade
To establish permanent shade in coffee, use leguminous species such as Guava (Inga mollifoliola, Inga parento), Poro (Erythrina spp) and Cuajiniquil (Inga edulis and Inga vera). Ideally, in a plantation there should be a diversity of bushes and forest plants native to the region and leguminous trees should represent 50% of shade species.

The spacing of shade trees can be 6x6, 8x8 or 10x10 meters, depending on the density of the foliage needed to ensure that 40%-50% of the coffee plantation has shade.

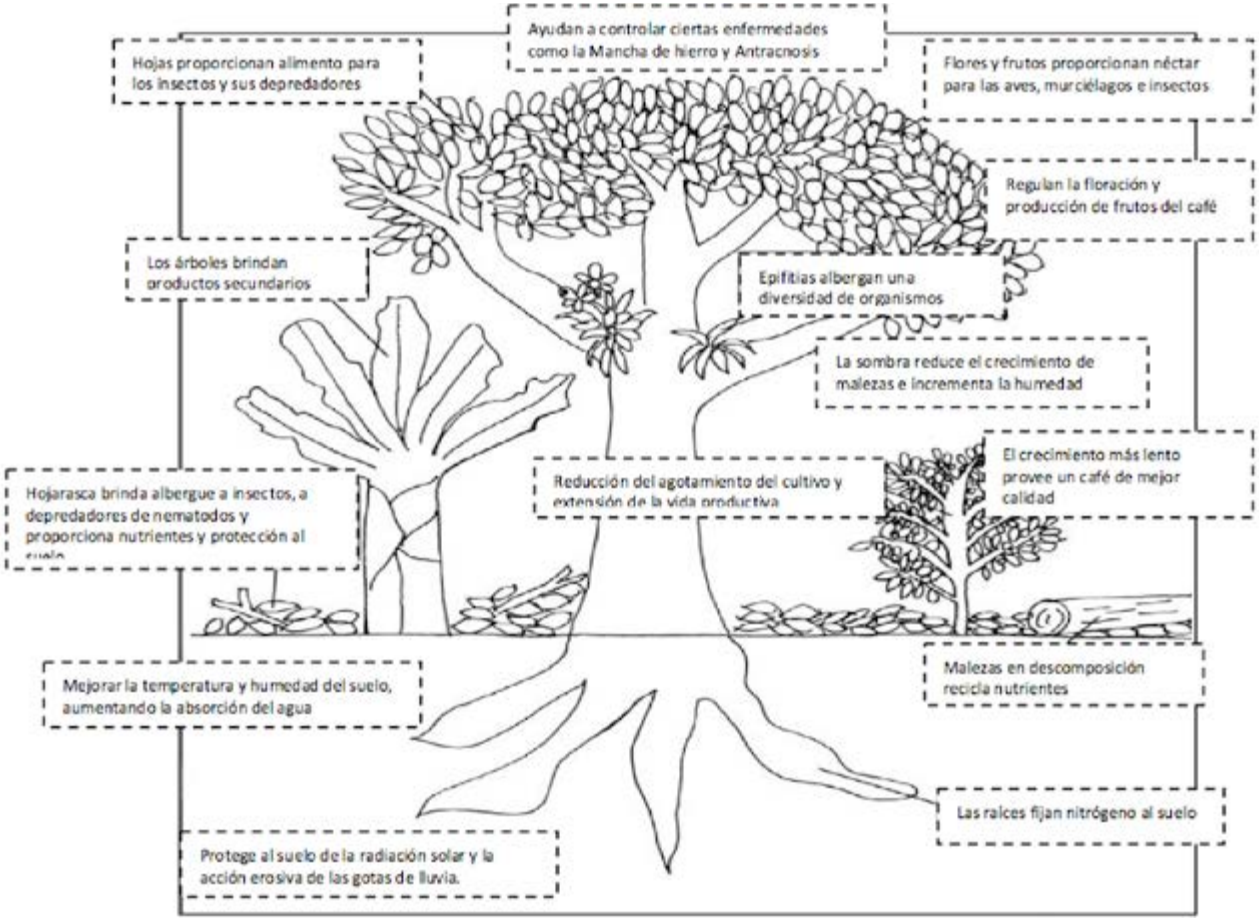
Different levels of shade should be present in the plantation. The use of bananas, plantains or citrus trees provide shade and are closest to the coffee, but they also provide food and organic matter (keeping in mind that they compete for nutrients).The middle level of shade is provided by Ingas and other leguminous trees of intermediate size which improve the microclimate, provide shade and fix nitrogen. They also provide nutrients and soil cover when their leaves fall to the ground. The top level of shade, represented generally by forest species (native or local species from the area) can provide timber products, give shade and also recycle nutrients.

Diferentes estratos de sombra en la plantación de café

Benefits of shade

The positive results of associating shade trees with coffee trees rely heavily on the types of trees used, the management of these trees and weather conditions at each site.

Studies conducted by CAFENICA and observations made by producers show that under certain management conditions and environment, shade can provide the following contributions



Species recommended for permanent shade trees are Black Guaba, Banana, Plantain, Bucaro, Crotalaria, Orange and Tangerine, Laurel, Black Madero, Copalchi, Chiquirín, Manza, Cuajiniquil, Cedar and Chaperno.

Maintenance and regulation of shade

There are many advantages of using trees in coffee plantations, but these must be carefully managed and the following must be taken into consideration:

- Generally, 120-140 shade trees per manzana are appropriate, based on the intensity of management and application of inputs.
- The plantation should have 40%-50% shade, which usually is not conducive for most diseases that attack coffee.
- Trees planted in association with coffee require special care, particularly for trunk formation and pruning of the upper branches.
- The lower branches of the shade trees should be at least twice as high as the coffee plants.
- Remove parasite plants (such as lianas or vines) that compete for nutrients and limit shade.
- After the coffee harvest, generally In February-March, vertical branches in the shade trees should be thinned to encourage coffee blossoming.

- Shade trees should be pruned two times a year:
  - » In May-June, right after the first rains. With this pruning there is a decrease in the amount of green coffee harvested at the end of the season. This pruning exposes the coffee to sunlight during the rainy season, which allows for increased efficiency in fertilizer use and avoids an increase in certain pests, such as the Red Spider and Leafminer.
  - » With more light and ventilation during the rainy season, the conditions are less likely to promote the development of diseases like coffee rust.
  - » In September-October, towards the end of the rainy season, some minor pruning is done to encourage ripening of the coffee berries.

Chart 1. Examples of spacing of trees in association with coffee trees

Shade trees	Distance in meters	Timber	Distance in meters	Fruit trees	Distance in meters
Poró (Eritrina poeppigiana)	6x4 6x6	Laurel (Cordiaalliodora)	10x10; 8x12;	Oranges, lemon, Mandarin Orange (Citrus sp.)	8x8 10x10 (regulated shade)
Guabas (Ingas sp.)	10x10; 10x12; 12x12;	Cedro (Cederla odorata)	12x12; 10x25;	Avocado (Persea americana)	8x8 8x10 (regulated shade)
Madero Negro (Gliricidia sepium)	6x8	Roble Coral, Amarillón (Terminalia amazonia)	5x5 6x6 8x8	Bananas, Plantains (Musa sp.)	8x8 8x10

Windbreaks

In areas where the wind is strong or consistent, fast growing trees should be planted to serve as windbreaks throughout the plantation.

Species for windbreaks preferably should be native. In addition, any leaf litter or shade from these should not have adverse effects on the soil

2.8 Pruning the coffee plantation

Pruning coffee plants is an important activity that ensures growth of new plant tissue, good harvests, increased yields and quality.

Pruning is the art of encouraging new growth on plants. When we prune trees and new growth occurs, the production off coffee is stable, the useful life of a coffee plant is extended and resistance to diseases such as Coffee Rust is increased.

Any kind of pruning method or system alone can provide only limited benefits. For pruning to be effective, it must be practiced in coordination with other good farming practices such as shade management, application of organic fertilizing, pest and disease control, weeds management and conservation of soil and water.

Many producers do not prune their coffee plants and if they do, they are generally inadequate due to a lack of knowledge of how to encourage growth of new plant tissue on their coffee trees.

When producers prune, they become producers of plant tissue and re-growth. For effective pruning, producers must know more about the plant:

1.The growth of coffee.

- The growth of the plant occurs both vertically and horizontally and is the product of two kinds of nodes or buds which:
- Develop vertical axes that are located at the base of each fruit-bearing branch on the main axis. These buds can develop into a new plant, and they are known technically as serial buds
- Develop secondary and tertiary fruit-bearing branches, which can vary depending on the variety of coffee, on which the development of fruit-bearing branches occurs. Production of secondary fruit-bearing branches can be encouraged through the stimulation of buds known as series heads.

2. Production throughout the life cycle of the plant

The plant begins berry production from the bottom of the plant and continues upwards to the top and outwards to the sides. Once branches have produced, they cease to produce and new berries grow only on new growth and branches. The production area is reduced, as the middle of the plant ceases production and the new growth areas increases their production.

Before the plant stops growing, selective pruning is required to avoid bi-annual production, in which plants grows one year and produce the following.

To prune coffee, there are a variety of manners, such as shortening, top-pruning, high pruning, low pruning, and full pruning that guarantee a balance of new tissue growth while maintaining the productivity of older tissue.

3. The Aging Process of the Coffee Plant.

The coffee plant does not get old based on the years since planting, rather by the amount of the crop produced on the tree.

The growth of productive fruit bearing branches decreases by 50% each year.

The coffee berries develop on the branches which grew during the previous years. Each new node produces fruit once. The number of berries per node decreases yearly and the further they are from the main trunk.

After several harvests, the coffee berries are located only at the ends of fruit bearing branches.

4. Production of new plant tissues or regrowth

Coffee pruning encourages new tissue growth or regrowth in order to guarantee future harvests. Production of regrowth compensates non-productive areas and production is maintained according to the type of management of tissues applied to the plantation.

For effective pruning, producers take into consideration a variety of agro-ecological factors such as weather, the time of year, moon phases and other factors such as the type of pruning done previously, the age of the plant, levels of shade and fertilization levels.

5. How the plant responds to pruning

When cutting or pruning a plant, growth and production are stimulated. The cuts or types of pruning are.

. Clean-cut

This practice consists of cutting the main stalk when the plant is 2 yards high. With this cut, vertical vegetative growth is interrupted, strengthening the main stem and encouraging regrowth where the cut was made. This cut also strengthens secondary fruit bearing branches.

- **Top-pruning**

(Experience of Jesús Castro Matamoros from the community of Las Escaleras in the Municipality of Matagalpa. Member of the Carlos Fonseca A. cooperative and partner of CECOCAFEN)

This practice entails cutting out old and unproductive branches which allows more productive life to the plant. The secondary growth branches are also pruned to allow for increased production per plant. Each new stem can produce 5 pairs of productive fruit bearing stems. The new branches which grow are then removed after each harvest, leaving only the two closest to the main stalk. This action is repeated until the Rock and Roll prune, described below, is achieved.

- **Rock and Roll**

This pruning practice takes place when the top of the plant is no longer productive, but where the lower portion of the plan still is. The cut is made one meter from the ground and several new branches are allowed to grow until the plant reaches about two meters in height. At this point they are pruned back, allowing for increased productivity of the plant.

- **Total pruning of the main stalk**

The cutting of the main stalk stimulates growth of several new stalks, which have the same vertical and horizontal growth features of the original stalk. This cutting must be done after the harvest and in the dry season. In the rainy season, the new growth grows weakly and the new branches may die. The cuttings must be cured with copper paste, lime, ash or sulpho-calcium paste.

- **Deshije**

An important task after cutting the main stalk, producers must thin out the new suckers, or sprouts which develop. This should happen between 2.5 to 3 months after the initial cutting, since there is less competition for space and nutrients and it is the right time to encourage healthy and vigorous regrowth.

- **Agobio**

This practice consists of bending the central stem and attaching the top of the coffee tree to the ground. This stimulates the growth of stems vertically out of the bent stem. This practice is best when the productive growth is concentrated at the top of the plant. Up to three stems can grow vertically out of the bent plant using this method..

- **Tools and supplies needed to prune coffee.**

- **Hand-held saw. Used to cut larger branches.**
- **Pruning shears. Used to eliminate smaller and diseased branches, as well as excessive new growth.**
- **Machete. Used to cut larger branches.**
- **File. Used to sharpen tools.**
- **Copper paste or sulpho-calcium paste. Used to cure cuts made to older branches**

- **Decreased yields after pruning**

When pruning unproductive trees, the harvest does not really decrease that much. Producers may even save some money by staggering the maintenance of pruned trees.

The apparent loss in productivity after pruning is quickly compensated with the increased yields obtained on these trees in 2-3 years.

2.9 Nutrition and Organic Fertilization of the Coffee Plantation

Organic agriculture considers the soil as a living organism, constantly changing and capable of providing the nutrients needed to ensure the development of strong and vigorous plants.

Only fertile soil can produce healthy crops, therefore soil is the most important resource farmers have. It is important for organic producers to understand the various factors that influence soil fertility because productivity and healthy plants depends on that fertility

Plants require many mineral nutrients to ensure healthy growth.

The nutrients are generally grouped into:

- **Macronutrients: required in large quantities, such as nitrogen, phosphorus, potassium, calcium and others.**
- **Micronutrients: required in small quantities but which are equally important, to include zinc, manganese, iron, boron and others.**

The requirements vary according to soil conditions and plant needs. Nutrients are added to the soil through organic mineralized fertilizers, mineralized bio-fertilizers and organic mixtures or additives.

Nutrition in organic agriculture aims to improve soil fertility, restore nutrients removed by crops and lost through runoff, and correct deficiencies of the soil. This is achieved by increasing the organic matter in the soil and promoting the macro and microbiological life of the soil itself.

Coffee plants extract the nutrients needed for growth, development and fructification from the soil. Farmers must therefore replenish these nutrients through organic fertilizers using the appropriate dosage, timing and frequency.

The use of natural fertilizers is important for maintaining good productivity and yields, as well as to strengthen plants to endure rust, pests and other diseases.

Coffee requires nutrients in adequate and balanced amounts for its development and production. For this, a soil analysis is recommended each year and appropriate corrective measures taken based on the technical recommendations of the analysis.

What is the Value of Organic Fertilizers?

Chemical Fertilizers

- They contain selected nutrients and these can generate deficiencies.
- They reduce the content of organic matter in the soil.
- They disturb soil organisms.
- They are easily leached.
- They are expensive.
- They need lots of energy to produce.
- They often do not produce the expected results

Organic Fertilizers

- They provide all the nutrients that plants need.
- They increase the amount of organic matter in the soil.
- They feed soil organisms.
- They nurture plants constantly and in a balanced manner.
- They represent a low risk of nutrient leaching.
- They are cheap.
- They are in many cases waste materials from crops.
- They release nutrients slowly over a long time.

Organic Fertilizer or Compost

Organic fertilizer results from the breakdown of animal and vegetable waste into humus. This process occurs when oxygen and high temperatures are present in the waste, and through the activity of bacteria and fungus, organic matter is decomposed. The use of organic fertilizers provides all necessary and essential minerals required for plant development and production.

Materials required for making a compost heap

- Organic residues: grasses, plants, weeds, degradable kitchen waste (separate out glass, plastic, nylon, metals and all other non-organic material)
- Coffee pulp
- Rock flour
- Some black soil
- Animal manure: chicken, rabbit, horse or cow (provided they do not come from intensive farms where high levels of synthetic chemical drugs are used)

Amounts required to produce 100 quintals - QQ (One QQ is equivalent to 100 pounds) of compost.

- 20 qq chopped-up organic material (straw, weeds, kitchen waste)
- 30 qq of fresh manure
- 20 qq chicken manure
- 10 qq coffee pulp
- 5 qq rock flour
- 5 qq Zeolite
- 10 qq black soil

Preparing the compost

There are several ways to prepare compost. One of them is in the form of lots. The procedure is described below:

1. Site selection:

- The site should be flat
- If possible, a small shed covered in plastic, zinc, grass or other local materials, can be erected to prevent rain damage
- The area should be completely shaded
- The site should be close to water
- Near the plantation, reduce transportation costs.

2.Build the lots with layers of materials

- The materials are placed in layers, similar to those found on a cake, as follows:
  - » 15 cm chopped organic material (straw, weeds, kitchen wastes)
  - » 5 cm of fresh manure
  - » 5 cm of coffee pulp
  - » 1 cm of rock flour
  - » 1 cm of Zeolite
  - » 2 cm black soil
- The operation is repeated until the height desired by the producer is reached.
- Once a lot is complete, it is covered with a layer of straw or plastic and watered. After 3 or 4 days the temperature should increase to 65° C. To test the temperature, a machete is stuck into the pile and if the blade is very hot when pulled out again, more water should be added to lower the temperature.
- The pile must be turned over in order to lower the temperature and also to accelerate the decomposition process of the organic material inside
- It is important to keep the compost lot relatively moist. To ensure the compost is moist enough, the producer grabs a bunch of compost in one hand and tightens it in their fist. If the clump of compost does not fall apart, the lot has adequate moisture.

For the United States an organic fertilizer is referred to as compost when it has ended a process that ensures an initial proportion de C:N between 25:1 and 40:1, as well as having maintained a temperature range of 55°-77° C for 15 days during which the materials were turned over at least 5 times; or for three days in a bin or static aerated pile, having been turned over 5 times.

After a month or two, the compost is ready. At this point it has a nice smell, much like forest mold. In addition, the original materials are not recognizable anymore.

3. Usage

- ***In nursery: 1 ounce per plant. If used as organic material, a mixture of 60% soil and 40% of compost is used.***
- ***Developing plants: half pound per plant***
- ***Recently pruned plants: two pounds per plant***
- ***Productive plants: two pounds per plant***

4.Frequency of application

- The recommendation is to apply this fertilizer once a year during the first two years and then to apply every other year beginning with year three.

Vermicompost

Vermicompost is the result of composting biomass (leaves, fruits, cattle manure, other organic material) using worms.

Materials needed to feed the worms

- Mixtures of organic waste, vegetable and crop residues, stubble, waste from having pruned trees and shrubs, weeds, coffee pulp and animal manure. These are fed to the worms every 8 to 15 days in 10 cm thick layers.
- Fresh cow manure in strips of 30 cm wide can be used every week to feed the worms. Coffee pulp can be applied weekly as well, either fresh or slightly decomposed in layers of 7 cm thick. Care must be taken in order to prevent the overheating of these materials. If a producer's coffee pulper can work without water, coffee pulp and mucilage can also be given as food.
- Keep in mind that these materials should not be hot, and preferably they have already began the process of decomposition.

Do not change the feed for the worms in each feeding, to avoid delays in the processing.

Obtaining earthworm humus

To remove the finished vermicompost, dry the top of the pile in order for the worms to burrow deeper into the soil or place food at one end of the container so the worms move to that end.

Earthworms are eaten by termites, ants, birds and hens, therefore they must be protected either by covering with material or placed on an airtight foundation.

.Application doses

- ***Nursery Plants: 4 ounces***
- ***Developing Plants: 2 pounds***
- ***Recently pruned plants: 2 pounds***
- ***Productive plants: 3 pounds***

To obtain a good composition of soil to use in a nursery, a mixture of 40% vermicompost and 60% fertile soil is recommended.

Vermicompost can be combined with other organic fertilizers as well, for example a 40% vermicompost mixture with 60% of organic fertilizer can be used on plants

Advantages of using vermicompost:

- Allows rapid transformation of dead biomass into excellent compost.
- Assists in rapid transformation of plantations affected by pests and diseases and improves development and coloration of coffee plants.
- High content of many nutrients, particularly phosphorus.
- Promotes the growth of plants.

Some farmers use the liquid waste from worms, also called slurry, which is the liquid that filters out of the box where the worms are kept. This is an excellent bio-fertilizer, which can be used as a foliar spray rich in vegetable hormones such as auxins, gibberellins, humus, humic and fulvic acids. It can also be used to combat pests (aphids) and diseases.

Bokashi

Bokashi is a fertilizer produced from a variety of ingredients and is a good source of major and minor nutrients. It is easy to prepare, providing mature compost in 15 days.

Ingredients: Chicken Manure (or another type of animal manure), coal, rice semolina, coffee pulp, lime or calcium carbonate, molasses or sweet cane sugar, yeast or forest mulch, clean soil and water.

In order to produce 22 quintals (QQ) of Bokashi, the following materials are required:

- 6.6 qq of rice or coffee husks from an ecological farm or one that has not been treated with synthetic chemicals
- 6.6 qq common soil
- 6.6 qq chicken or other animal manure
- 3.3 qq coal in powder form
- 30 pounds of lime (Agricultural lime or dolomite)
- 1 gallon of molasses or six bundles of brown sugar cakes. If there is no molasses available from organic farms, producers can melt 6 bundles of brown sugar cakes obtained from organic farms, or those under traditional management, where synthetic agro-chemicals are not used.
- 4.8 ounces of bread yeast

This recipe can vary depending on available supplies. In any case, inputs from organic or traditional farms without agrochemicals should be prioritized.

Preparation

To prepare bokashi, the ingredients can be set in layers, starting with rice husk, coffee pulp, soil and manure, followed by the coal, lime, molasses and yeast. These last two ingredients must be dissolved in water.

In order to mix the ingredients, they should be turned. The molasses and yeast mixture is added after each time the bokashi is turned during preparation. Once the entire pile is thoroughly mixed and uniform in moisture, it is spread on the ground in layers not more than 50 centimeters thick.

To control the temperature during the decomposition stage, the bokachi is turned and aerated twice (morning and afternoon) during the first five days. In the last ten days, the mixture needs to be turned and aerated only once a day. The mixture must be left in a layer not exceeding 50 centimeters.

Doses

Producers should be careful in using Bokashi due to its high calcium content, which could negatively affect some plant development. For use in nurseries, the recommendation is to use the bokashi after it has aged three months. For use on plants older than two years, six pounds can be applied around the base of the plants, while three pounds per year can be applied on developing plants

Coffee Pulp

This type of fertilizer is used in different ways:

- Fresh or semi-fermented: it is applied directly to the plantation, between coffee rows or directly around the plants.
- Once stored, it can be used to produce compost, Bokashi or given to worms as food.

Application

Coffee pulp is applied after draining of all liquids and deposited in a thin layer around the base of the plant, ensuring it stays clear of the stem itself. A minimum 10 pounds per tree per year can be applied. Coffee pulp is excellent, provides good nutrients, gives the soil good moisture retention capacity, increases the bacterial flora, prevents compaction and allows better aeration. It also controls weeds.

¿When and how much organic fertilizer can be applied to the coffee plantation and how?

For organic fertilizers, there are no generic recipes which mandate the precise amount of fertilizer to use for each plant. This is because of the different inputs used and the physical and chemical characteristics unique to each fertilizer. It is necessary to analyze the soil and fertilizer to determine suggested amounts per plant. However, the following are general recommendations to follow:

- Apply at the beginning of the rainy season
- If the farmer does not have enough fertilizer, it should be applied only to plants that need it the most.
- For an improved use of nutrients and microbial activity, organic manure should be applied around the base of the plant, in a circle about half way between the tree stalk and the edge of the leaves. On sloping ground, the earth on the upper side should be dug out and placed on the lower side to allow for a flat surface on which to place the fertilizer.
- To protect from run-off, the ground should be thoroughly loosened and the fertilizer buried under a cover of crop residue or earth.
- Every effort to apply organic fertilizer or compost must be accompanied by complementary soil conservation practices (shade management, terracing, live or dead barriers with mulch, and wind breaks).

Other soil conservation and erosion control practices are recommended, as they also complement the use of natural fertilizers. These can be allowing leaf litter to accumulate on the ground as temporary or permanent shade, incorporating vegetative material into the ground and planting leguminous cover crops to fix nitrogen in the soil.

Bio-fertilizers

Bio-fertilizers are used to nourish, restore and revive soil life, as well as strengthening plants. At the same time, their use protects crops against insect attacks and disease. On the other hand, they are useful in replacing highly soluble synthetic chemical fertilizers, which besides being very expensive create dependency for peasants, making them poorer.

Materials and supplies required to produce 200 liters of bio-fertilizer.

- Plastic barrel with 200 liters capacity
- 50 pounds of fresh cow manure or squash residue
- 5 pounds of ash
- 15 bundles of brown sugar or 10 liters of molasses
- 10 liters of milk or whey
- 10 pounds of ground corn or 5 pounds of semolina
- Water honey from the coffee processing, to be used to top up the remainder of the plastic barrel instead of water.
- If there are resources available to use minerals (such as boron, potassium, zinc, magnesium and manganese), 1 pound of each of these minerals.

¿Preparing the biofertilizer?

- Using the 200 liter plastic container, dissolve 50 pounds of fresh cow manure and 5 pounds of ash in 100 liters of water or honey water. Stir until well blended. If possible, collect the cow manure in the morning; the less sun shine it receives, the better the bio fertilizer.
- In a plastic bucket, add 10 liters of milk or 20 liters of whey, 10 liters of molasses and then dissolve a pound of each of the minerals, stirring until blended together.
- Add the latter mixture to the 200 liter container, top off with water or honey water until there are 180 liters of mixture and stir well till thoroughly blended.
- Seal the container in order for the anaerobic fermentation to begin and connect the gas escape mechanism, which generally consists of a plastic hose connected to a half-full plastic bottle of water.
- Place the plastic container in the shade at room temperature, making sure it is not in direct sunlight or rain. After 20-30 days, open the container to check quality, smell and color. It must not smell rotten, nor can it be blue-violet in color. The smell must be that of fermentation.

In very cold areas, fermentation can take up to 50-60 days.

Dose of application:
The bio-fertilizer must be applied as follows:

- For nursery plants: half a liter per 20-liter spray pump.
- For development and production plants: 1 liter per 20 liter spray pump.

Do not forget to strain the bio-fertilizer prior to use.

Producers should make at least four foliar applications of bio-fertilizer each year: one to promote vegetative development (February-March), one at pre-flowering (March-April), one after flowering (June), and the fourth for the growth of the berries (August-September).

To decrease labor costs, the bio-fertilizer can be mixed with a Sulpho-calcium mixture (1 liter of bio-fertilizer and half liter of Sulpho-calcium mixture) for disease prevention and nutrition.

In the case of organic fertilizers and / or bio fertilizers which contain manure, these must be applied at least four months prior to harvest, as outlined under the National Organic Standard of the US.

Honey water

Honey water is a product of washing the coffee berry after fermentation.

The hone water is stored in barrels or plastic containers and applied in the nursery and directly to the plants, in order to prevent diseases like rust and iron stain. In dry weather it is also used to refresh coffee trees and avoid burning. Some producers mix the honey water with mineral mixtures and apply directly to the base of the plant.

Note

In the chapter on pests and diseases, an explanation is provided for the preparation of minerals mixtures including ash, Sulfate-calcium, Vicosa, and Bordeaux that function as foliar fertilizers in the pre- and post-flowering stage of the plant. These can be applied also during the pre- and post-harvest stage of the coffee. These mixtures help maintain a nutritional balance in each of the growth stages of the crop.

Plan de fertilización

No	Producto	Aplicaciones	Fechas de Aplicación	Unidad de Medida	Cantidad mz	Recomenadacion
1	Aplicación de biolfertilizante mineralizado	2	Febrero-Marzo	Litros	40	Para mejor efectividad pueden realizar mesclas de biofertilizantes con los caldos minerales para disminuir costos de producción y mejorar la nutrición y control de enfermedades de los cafetales .
2	Aplicación de biolfertilizante mineralizado	2	Abril-Mayo	Litros	40	
3	Aplicación de biolfertilizante mineralizado	1	Mayo- Junio.	Litros	40	
4	Aplicación Preventivas de Caldos Sulfocalcico	2	Mayo-Julio	Litros	24	
5	Aplicaciones de caldo Bordelés	2	Junio-Sep.	Litros	200	
6	Aplicación de biolfertilizante mineralizado	1	Junio- Julio	Litros	20	
7	Aplicación de abono edáfico	1	Mayo-Sep.	Quintales	33	Se realiza una aplicación por año
8	plaguicidas	2	Julio- Sept.	Litros	80	Control de broca, Minador y otras plagas

Nota: Para la fertilizacion organica de una mazana de café, incluyendo la mano de obra se necesita una inversion aproximada de 609 dolares

Costos de insumos

No	Producto	Aplicaciones	Fechas de Aplicación	Unidad de Medida	Cantidad	Precio Unitario C$	Precio Total C$	Monto US
1	Aplicación de biolfertilizante mineralizado	2	Febrero-Marzo	Litros	40	10	400	15
2	Aplicación de biolfertilizante mineralizado	2	Abril-Mayo	Litros	40	10	400	15
3	Aplicación de biolfertilizante mineralizado	2	Mayo-Junio	Litros	40	10	400	15
4	Aplicación Preventivas de Caldos Sulfocalcico	2	Mayo-Julio	Litros	24	15	360	14
5	Aplicaciones de caldo Bordelés	2	Junio-Sep.	Litros	200	1,5	300	12
6	Aplicación de biolfertilizante mineralizado	1	Junio- Julio	Litros	20	10	200	8
7	Aplicación de abono edáfico	1	Mayo-Sep.	Quintales	33	145	4785	184
8	Aplicación de insecticidas Orgánicos	2	Julio-Sept	Litros	40	20	800	31
	TOTAL						**7645**	**294**

Costos de mano de obra

No	Producto	Aplicaciones	d/h	Precio Unitario C$	Precio Total C$	Monto US
1	Aplicación de biolfertilizante mineralizado	2	8	130	1040	40
2	Aplicación de biolfertilizante mineralizado	2	8	130	1040	40
3	Aplicación de biolfertilizante mineralizado	2	8	130	1040	40
4	Aplicación Preventivas de Caldos Sulfocalcico	2	8	130	1040	40
5	Aplicaciones de caldo Bordelés	2	8	130	1040	40
6	Aplicación de biolfertilizante mineralizado	2	8	130	1040	40
7	Aplicación de abono edáfico	1	7	130	910	35
8	Aplicación de insecticidas Orgánicos	2	8	130	1040	40
	TOTAL				**8190**	**315**

Tener presente que en fincas certificadas los insumos (estiercol, pulpa, cascarilla, desechos vegetales, etc) que no se encuentren disponibles en las mismas fincas deberán provenir de una producción ecológica o en su defecto fincas tradicionales sin uso de agroquímicos, sin excepción.

En el caso de intención de uso de azufre, cobre, cal, micronutrientes u otros insumos externos estos antes de ser utilizados deberán ser autorizados por BIO LATINA con el objetivo de evaluar su compatibilidad de uso en agricultura ecológica.

2.10 Soil and water conservation practices in coffee plantations

Soil is a product of infinite relations and forms of life, from macro organisms (mammals, arthropods, mollusks, earthworms, millipedes, ants, etc.) to microorganisms (bacterial and fungal microorganisms) involved in the formation of organic matter.

Each of these organisms has a specific role, and their absence breaks the balance in a healthy and fertile soil. Based on these principles, efforts have to be made to preserve their physical, chemical and biological properties.

The water, wind, man and animals cause erosion or soil loss in the coffee plantations.

The majority of plots managed by smallholder producers are located on steep slopes with poor soils. Soil and water conservation interventions must be carried out to ensure fertility and conservation, to minimize erosion and maintain soil fertility for the long term as coffee is a perennial crop.

Practices that can be implemented to conserve soil and water

1. Soil Coverage

To cover-up bare soil, it is necessary to protect it with cover crops which prevent erosion and fix nitrogen.

For this we can use the following beans:

a) Gandul, Pigeon pea (Cajanus cajan)
b) Velvet bean (Mucuna pruriens)
c) Canavalia, Jack Bean (Canavalia ensiformis)

¿What benefits does cover cropping provide?

1. Prevents the growth of weeds
2. Protects the topsoil from runoff
3. Improves soil texture and structure
4. Incorporates nitrogen
5. Improves soil porosity
6. Retainss soil moisture
7. Constantly recycles nutrients

2. Live barriers

Live barriers are plants purposefully located on contour lines throughout the plantation and between the rows of coffee to prevent erosion of organic matter and soils.

For live barriers, Saint George's Sword (Iris germánica) is recommended where there is shade and, if there is sufficient sunlight, valerian and lemon grass.

3.Dead Barriers

Dead barriers are stones or dry sticks collected from thinning or regulating shade and are placed along the contour lines in the plantation or between the rows of coffee to prevent erosion of organic matter and soil.

To know where to put the barriers and distance between each other, we must use the following table.

4. Dikes

Dikes are soil conservation works made where the excessive runoff from rains generally flows. They are barriers that stop the force of flowing water, and prevent soil from sliding during heavy downpours. Dikes can be made with dead materials (sticks and stones) or living materials (stalks pruned from trees).

5. Ditches

The ditches are trenches built along contour lines to retain and increase water filtration from rainwater. They are built next to windbreaks and dead barriers. They can be 33 inches wide and 20 inches high.

6. Windbreaks

Windbreaks are live plant barriers that protect crops from the wind. They assist in diminishing wind erosion, damage to the coffee plants by strong winds, drying of the soil and the low production. In most coffee plantations these barriers are made of Espadillo (Crotalaria sagittalis) and Hybiscus.

7. Individual terraces

These are small terraces in the shape of a half moon that are built to retain runoff during rains, decrease the chance of landslides and keep moisture in the soil. These should only be used during the early development stage of the coffee plants, as they can damage the root systems in older coffee plants.

2.11 Main diseases and pests that affect coffee

Coffee diseases

Pests and diseases in coffee are caused by improper management and indicate the nutritional status of plants. The main actions necessary for improved environmental management of pests and diseases are:

- Stimulate, defend and strengthen functions performed by natural disease controllers within the plantation system.
- Reduce the population of insects, pests and the percentage of diseases through appropriate cultivation practices (using plant associations, crop rotation, resistant varieties selection, good soil preparation, application of herbal preparations and live barriers).
- Reach a balanced nutritional environment through fertilization practices and soil conservation techniques.

Tabla 1. Main pests and insects that affect coffee

Common name	Scientific Name	Part of the plant affected
Leaf spot	Cercospora coffeicola	Leaves, fruit
Antracnosis	Colletotrichum coffeanum	Branches, leaves, fruit, flowers
Rust	Hemileia vastatrix	Leaves
"Ojo de gallo"	Mycena citricolor	Leaves, fruits
Common name	Scientific Name	Part of the plant affected
Coffee Berry Borer	Hypothenemus hampei	Fruits
Nematodes	Meloidogyne sp	Root

These diseases and pests can cause the following damages:

- Defoliation
- Reduction in the growth of new plant tissue
- Decreasing the lifetime of the plant
- Expose the plant to other problems
- Less filling and ripening of fruit
- Decrease coffee quality, increasing "burnt" and unripe coffee
- Decrease in yields
- Decrease the proportion of coffee berries to green coffee
- Reoccurrence of diseases, such as ru

Tabla 2 .Characteristics of varieties against selected pests and diseases

Varieties	Rust	Leaf Spot	Nematodes	Antracnosis	Leaf Miner
Típica	S	S	T	S	S
Caturra	S	S	S	S	S
Catimor	R	S	S	S	S
Robusta	R	T	R	T	T

R: resistant, T: tolerant, S: susceptible

1.Main diseases that affect coffee prior to final planting

Damping off disease

Symptoms of the disease

Damping off: Caused by a fungus (Pythium Rhizoctonia,
Fusarium)

How to recognize it

Less emergence of seedlings.

Dark spots at the base of the stem, strangulation.

How it develops

- Soil fungus.
- High humidity, poor aeration, slightly acidic ph, temperature between 10-23 degrees Celsius, unfavorable seed germination.
- Planted too deep in the soil.

Favorable conditions for the presence damping-off

- High soil moisture, flooding
- Seeds with low germination and vigor
- Seeds planted too deeply in the soil
- Planting seeds too closely together

Preventive actions against Damping-off

- Use new and good quality seed
- Ensure soil is 10-20 cm. deep
- Do not use soil from coffee plantations, nor in which horticultural products or grass has been grown.
- Application of lime, particularly in the seedbed, at a rate of 2 pounds of lime (or 4 pounds of ash) per square meter
  - » ***Physical methods***
  - » Pouring boiling water on the soil, at the rate of 3 liters per square meter. Seedling can be planted a week later.
  - » Exposure to direct sunlight for 7 days, placing soil under a clear plastic sheet.

2. Common diseases after coffee has been transplanted (seedbed and nursery)

A. Rust

(Hemileia Vastatrix)

Symptoms

- Oily spots on the top side of the leaves.
- Orange dust on the underside of the leaves.

Conditions for its development

- Older leaves on the ground.
- Too much moisture in the soil.
- High humidity in the air
- Low temperatures
- Low levels of light

Cultural Control

- Use resistant and tolerant varieties.
- Appropriate density or number of plants per manzana to allow adequate aeration, between 3,000 - 3,500 plants, depending on the slope of the plantation.
- Proper shade regulation, not to exceed 40% of shade in the plantation.
- Thinning of shade trees in June, September and November.
- Application of adequate nutrition to the soil or through foliar sprays.

Cures to control diseases caused by fungus in coffee

Visosa broth:

The visosa mixture protects the coffee from rust, controls most diseases caused by fungus and strengthens the plant nutritionally.

To prepare 100 liters of this mixture, the following ingredients are required:

- 500 g copper sulfate
- 500 g hydrated lime
- 600 g zinc sulfate
- 400 g magnesium sulfate
- 400 g boric acid
- 2 Plastic tubs (one of which must be able to hold 100 liters of liquid)
- 1 Machete or piece of iron
- 100 liters of water

How to prepare:

1. Dissolve the copper sulfate, zinc, magnesium and boric acid in 50 liters of water.
2. In the other tub dissolve the lime in 50 liters of waters.
3. Pour solution from tub 1 into the tub with the dissolved lime (never backwards), stirring constantly until thoroughly mixed. It is now ready to apply.

How to use:

- Apply every 30 days, except for when the coffee plants are blooming.
- Recommended as a preventive measure.
- Can be applied at the same time or alternatively with Sulfate-calcium mixture.

¡Aplíquelo inmediatamente al cultivo o vivero!

Bordeaux mixture

The Bordeaux mixture is used to control most fungal diseases such as rust, iron stain, "Ojo de Gallo" and Anthracnosis. It replaces copper-based fungicides.

Ingredients: To prepare 100 liters you need the following

- 1 kg copper sulfate
- 1 kg hydrated lime
- 2 plastic tubs or containers (one of which must be able to hold 100 liters of liquid)
- 1 Machete or piece of iron

How to prepare:

1. Dissolve the copper sulfate in 10 liters of water.
2. In the other tub, dissolve the lime in 90 liters of water.
3. Pour the copper sulfate from the first tub into the tub with the lime, never the other way around, and stir constantly.
4. Check the acidity by dipping a machete in the mixture for a minute, allow to dry and check for rust. If there is rust, the mixture requires more lime. If the machete shows no rust, the mixture is ready to use.

How to use:

- Add between half a liter to one liter of this mixture to a 20 liter spray pump. For use in the nursery, do not apply more than half a liter, as it may burn the plants..

Sulfate-calcium mixture

This mixture nourishes plants as well as preventing and curing fungal diseases, such as rust. It also acts as a repellent, insecticide and acaricide.

This product can be applied to coffee plants up to two months prior to the harvest to avoid affecting the quality of the berry.

To prepare 100 liters, the following ingredients are needed:

- 20 kg sulfur
- 10 kg of lime
- 1 metal barrel that can hold 100 liters of water
- 1 wood stove
- 100 liters of water

How to prepare:

Add between half a liter to one liter of this mixture to a 20 liter spray pump. For use in the nursery, do not apply more than half a liter, as it may burn the plants.

The green-colored paste left over from the process can be stored and applied to the cuts on trees after pruning.

How to use:

- Use 2 liters per 20 liter spray pump on mature plants. In nursery, use 1 liter per spray pump.

Ash Mixture

The ash mixture is used to prevent fungal diseases and also provides necessary nutrients for the plants.

To prepare 100 liters of ash mixture, the following ingredients are needed:

- 25 kg ash, in powder form
- 2.5 kg soap
- 1 metallic tub
- 1 Firewood stove
- 100 liters of water

How to prepare:

1. Add 25 kg of ash and 2.5 kg of soap to 100 liters of water. Place on stove and boil.
2. Stir with a stick for 25 to 30 minutes.
3. Let it cool. The mixture is ready to use.

How to use:

- Use 2 liters per 20 liter spray pump on mature plants. In nursery, use 1 liter per spray pump.

Recommended dosage for different mixtures

Treatments	Dosage
Sulfate-Calcium mixture + Micro nutrients (Boron and Zinc) (Ant)	1L/bomba
Visosa mixture (Anthracnose and Rust)	1 liter / pump
Bordeaux mixture (Anthracnose and Rust)	1L/bomba
Sulfate-Calcium mixture (Anthracnose and Rust)	1 liter / pump
Ash mixture	1 liter / pump
Bio-fertilizer + Sulfate-Calcium mixture (Anthracnose)	1 liter / pump
Bacillus thuringiensis (rust)	2 liter / pump
Verticilium (rust)	1 liter / pump
Trichoderma (rust)	
Verticilium (rust)	44 g / plot of land
Trichoderma (rust)	44 g / plot of land

B. Antracnosis (Collectotrichum)

Symptoms

- Irregular Spots
- Dark and defined edges
- Black spots in the center

Conditions

- Survives in living or dead plant tissue
- High altitude areas (mist, rain, Temperatures between 10-30o C)
- Stressed plants
- Sun, bad nutrition

C. Ojo de gallo (Mycena citricolor)

Symptoms

- Leaves and fruits in different stages of development. Circular and oval spots, defined edges.
- Presence of small growth on berries.
- Holes and open sapces in the plant tissue.

Conditions

- Survives in soil and in leaves under shade
- Highland areas above 900 meters
- The impact is highly localized in the plantation. High air humidity, a lot of rain, cloudiness.
- Low temperature
- Excess shade

D. Iron stain

Cercospora coffeicola

Symptoms

- Circular leaf spots, gray in the center, brown along the edge, yellow halo, tiny growth at the center of the spot.

Conditions

- It survives in leaves and fruits.
- Little shade, high temperatures, high humidity in the air.

If sulfur, copper, lime, micronutrients or other external inputs are to be used, producers must have permission and approval from BIO LATINA prior to their use in order to assess their compatibility for organic farming.

II. Coffee pests

A. Coffee Berry Borer (Hypothenemus hampei)

The coffee berry borer reduces the physical and organoleptic quality of the coffee bean.

The female bites the small and thick fruits, causing them to fall and rot. This reduces the amount of berries for harvest. It also digs holes and lays its eggs in nearly-ripe fruits. The larvae then eat and develop in the coffee berry, causing greater losses. Its life cycle is 23-30 days (at 24□) or 12-15 days (at 19 □).centígrados).

Periodos de afectación de la broca

¿How to control it?

1. Manually:

- During the HARVEST: avoid leaving fruits on the plant and on the soil
- During final gleaning stage of the harvest: collect all fruits from the ground
- During the final phase of harvest: remove all fruits from the plant
- During the middle stage of the harvest: picking all affected fruits (even if they are still green, yellow-green, ripe and black)
- During berry growth and development: pick premature berries which are the product of irregular blooms. These can be picked 60 days after flowering. Pour boiling water over affected berries.

2. Traps, attractants:

- Use 50% ground coffee with 50% honey water/mucilage mix.

Making home-made traps

Captured berry borers

3. Biological control:

- For biological control of the coffee berry borer, natural enemies (parasites) such as beauveria bassiana need to be brought to the plantation and released through a biological management program.

B. Nematodes (Meloidogyne sp)

- Worm-shaped microscopic organisms with cylindrical, elongated bodies which vary in size (can be between 0.1 - 3 mm in length)
- Aquatic in nature
- Live on the soil most of the time and survive by eating roots
- Size makes it difficult to recognize with the naked eye

Nematode

Agallador Meloidogyne

¿How is it recognized??

- Galls or secondary nodules on roots.
- Stunted plants.
- Yellowing of leaves.
- Leaf loss.
- Fruit fall.
- Weakening of the plant.
- Death of the plan

¿How does it develop?

- Temperatures from 20 to 30o C
- 70-80% Humidity in the air.
- 40-60% soil moisture, sandy soils.

Management of nematodes

- Do not transport infected plants
- Soil testing prior to establishing plantation
- Rotate with non-host crops
- Sun treatment of seedbeds and transplantation beds
- Application of molasses on infected ground
- Use of organic fertilizers
- Use of cover crop and natural repellents (legumes, San Diego plant)

By biological means:

- Use of the Paecilomyces lilacinus fungus, which infects Meloidogyne sp eggs.
- Use the Anthrobotys sp. fungus which catches nematode larvae through sticky rings.

Chapter 3
Good experiences in improving productivity and managing coffee rust

3.1 Pruning after Coffee Rust

Not everything is lost after a coffee plantation is pruned from a rust attack, as Juan Iglesias and his wife Elsania Vaquedano, from the community of Las Brisas, municipality of San Juan de Río Coco, explain:

"The first rust attack took place in October 2011 and what we did was to prune in blocks. All you could see was the bare earth and trunks."

¿What we did?

We experimented to see how to get back our coffee. On our farm we have some demonstration plots supported by CAFENICA and Lutheran World Relief. On one plot, three months after the new coffee plants grew out, we applied two pounds of mineralized compost per tree, we also did 10 fumigations in one year with bio-fertilizer and sometimes alternatively with sulfate-calcium mixture and visosa mixture, at a rate of:

- 1 liter of bio-fertilizer
- Half liter of visosa mixture
- Half liter of sulfate-calcium mixture
-

Today, this area has produced two harvests, is healthy and full of berries.

Now we do not neglect the plantation, and we know we have to live with rust and to keep it under control. To do this, we have to nourish the plant and do preventive applications.

PRUNING after Coffee Rust

Healing: After pruning, trees must be treated with sulfate-calcium paste.

Nutrition and fertilization: sA producer must apply 1 pound of mineralized compost to the soil and spray at least 5 times a year. The application of compost should be done a few days before the rains start.

Foliar sprays are made when new leaves have emerged. They can be made using bio-fertilizer alternating bio-fertilizer with other foliar sprays, to prevent the diseases development.

It is recommended to do 5 fumigations a year; 2 bio-fertilizer sprays and 3 preventive applications of bio-fertilizer before the month of September.

Thinning of new growth: leave one or two shoots per plant, preferably locating them about one or two inches below the cut of the pruned branch.

3.2 Handling rust with fertilization and prevention

The nutrition of coffee plants in the soil and foliage makes them productive and more resistant to pests and diseases. Rust is a disease that has always existed in coffee plantations, but when it is not fertilized or treated, rust can destroy a plantation.

This was proved on Juan Francisco Balladares' farm located in the community of Las Brisas, Municipality of San Juan de Rio Coco. He participated in the Coffee Rust Project which was funded by Lutheran Relief Services.

"In my case, the rust affected a part of the plantation and I had to prune. It wanted to start again and it was affecting 12% of the plantation.

That is when I started fertilizing the soil and spraying the foliage with a mixture of ingredients that was recommended by a technician of the UCPCO co-operative.

So, I:

1. 1. Used mineralized compost in the soil, placing one (1) pound per plant.

To make the mineralized compost with rock flour and zeolite, one needs to mix 5 - 6 qq of these with 22 qq of compost. This is applied around the base of the tree at a distance from the trunk equivalent to half of the length of the lowest fruit-bearing branch.

This has to be covered with leaf litter or soil, so that rain doesn't wash it away

2. Fumigated with a combination of sulfate-calcium mixture, ash mixture and honey water:
   - Half liter of sulfate-calcium mixture
   - Half liter of ash mixture
   - 1 liter of honey water that I collect from the harvest

Per 20 liter spray pump.

These three products work together in one single application; they refresh the plant, fertilize it and attack the disease. Even when the disease is not developed, this foliar spray prevents its development.

Besides, it is one job, which lowers the cost.

¿What did I achieve?

I made one foliar application each month, from the beginning of the rains, and after three applications I was able to lower the incidence of rust from 12% to 7% on my farm.

That is why today I recommend that producers not wait for the disease to develop, but they should make 3 - 5 preventive applications per year, because the organic producer has to live with the rust and with other diseases, but if you nourish and make preventive applications you will be able to control it.

You can attack and prevent Rust by fumigating on time and keeping your coffee plantations nourished.

Note:The Visosa and Sulfate-calcium mixtures should be applied from May to September. They should be applied up to two months prior to the harvest, as they may affect quality.

The Bio-fertilizers can be sprayed up to 10 times and throughout the year.

Nourishment of the coffee plantation

The bio-fertilizer nourishes the plant, promotes the ripening process and grain filling and avoids fruit drop, which happens when a plant is not well-nourished.

The mineralized compost nourishes the plant and gives it the minerals needed to be more resistant to pests and diseases.

3.3 Fertilization and management: Keys to good production and rust control

The Fertilization and management of plantations not only produces better crops, but also protects coffee from rust and other diseases, as Ms. Eudora Gómez Chavarría, member of the Omar Martinez Cooperative and affiliated to SOPEXCA, from the community of Santa Isabel from Jinotega, explains:xds

" Here we had rust attack mostly in 2012, but it did not affect the entire plantation. To fight against it we used three essential things: Sulfate-calcium mixture: we applied it monthly up to 7 times a year, using 1 liter per 20 liter spray pump. We fertilized with supermagro, a foliar bio-fertilizer enriched with minerals created by ourselves and that we apply every 15 days or every month. And we apply bio-perla, enriched compost supplied by SOPEXCA which we apply to the soil. These applications have to be constant so they work, you have to make them once a year, every year, when the rainy seasons starts"

Important actions in the coffee plantation necessary to handle rust are:

- Conservation of the soil with live barriers of Saint George's Sword (Iris Germánica) and dikes where gullies are made.
- Weeding at least 4 times a year with a machete.
- Diversified shade trees which include timber and fruit products.
- Do not leave the trimmings left over from the pruning or the shade trees on the ground. These have to be removed the next day after being cut so that diseases do not remain in the plantation.

With this type of handling you can guarantee a healthy coffee plantation and a production level of 35 - 40 bags of coffee per manzana.

¡There is no such thing as a bad plant; however, there are poorly managed plantations. That is why today we are not afraid of rust!

Supermagro

Supermagro is created by ourselves with the support of SOPPEXCCA, which looks for the minerals in Managua and then sells it to us at a favorable price.

To prepare a barrel of 200 liters the following ingredients are required:

- 1 kg of zinc
- 1 kg of boron
- 1 kg of calcium
- 1 kg of copper
- 1 kg of magnesium
- 1 kg of potassium
- 1 kg of sulfur
- 1 kg of manganese
- A little bit of iron sulfate. (This mineral is hard to get so we use 2 - 3 iron nails)
- Between 15 - 25 pounds of cow manure
- 10 liters of molasses
- 10 liters of whey
- Yeast
- Half a pound of ground fig tree seeds, as adherent and preservative

¿How is it prepared?

- Boil the water and dissolve all the minerals in it.
- Separately, mix the livestock manure, molasses and whey, and then add the minerals previously dissolved in water.
- Pour everything in a barrel, stir well and refill it with water without the mixture reaching the top.
- Add the nails (which will disappear in 40 days) and grounded fig tree seeds. These seeds serve as a sealant, adhesive and preservative because they are so oily.
- Check the fermentation process by uncovering the tank, and if it has a dark-blueish color and smells bad, it requires more lime and molasses. If it smells like sugar-cane liquor and is greenish in color, the fermentation is going well. It has to be fermented for 35-40 days.

¿How is it used?

- Use 20 liters per 200 liter barrel.

Eight days after applying, you will see the difference in the plantation.

BioPerla compost

BioPerla is compost enriched with minerals, legumes, rock flour, coffee pulp and malanga leaves. It is formulated by SOPPEXCCA and sold to members at C$180 per qq.

Apply one pound to plants in production and half a pound to small or recently-pruned plants, covering it with leaves or loose soil so it doesn't wash away.

Esteban Martinez, from the community of San Miguel in Jinotega has applied 50 qq of BioPerla per manzana and has obtained yields of 40 qq of parchment coffee per manzana.

Mineralized compost

There are other experiences of mineralized compost such as Elia Castillo Rugama, from the America community in Jinotega. She is a member of the Osman Martínez cooperative, which is a partner of SOPPEXCCA:

"Since two years ago we've been producing compost that we make ourselves using coffee pulp, fertile soil, ash that we collect throughout the year from the kitchen, bananas stems, green leaves and livestock manure. We place the materials in 3-4 inch layers, ten wet it, cover it and check the temperature. We turn it over every 30 days. You have to apply it when there's enough soil moisture and at a proportion of 1.5 - 2 pounds per plant. Sometimes we mix it with BioPerla compost to guarantee better fertilization. We first apply the BioPerla compost then a few months later we apply our compost. We also do 3 applications of Supermagro, one in the dry season and two in the rainy season. With these applications, the Catuai coffee variety, which is more resistant to rust and also of excellent quality, we have lowered the rust impact and we believe that in the next couple of years we can reach a production of 30 qq per manzana in the area that is being renewed."

3.4 The secret against rust: mineralized Compost and biominerals

Martin Vicente Padilla, from the community of Yasica Sur, located in the municipality of San Ramon, four years ago established 1 1/2 manzana of coffee and with the handling he has given to it by fertilizing the plant and soil with mineralized compost and the foliage with bio mineral, he has not had rust attacks and has a good coffee production.

"The secret to prevent rust or other illness is to nourish the plants well and this starts from the sowing."

1. Planting the coffee

We must make the large holes, of two hand spans in width, which is around 18 inches, by two hand spans in depth, for planting banana trees. You have to remove the poor soil from the hole and fill with a mixture of mineralized compost (4 pounds per plant) and humus or topsoil (2 - 3 pounds), generally the top 5 cm of virgin soil, to finish filling the hole. Then after a full year, the earth is loosened up and the plant material from the plant is deposited around it. In this way, the coffee plants are covered with nutrients.

Mineralized compost formula:

Mineralized compost is made with everything I have on the farm: manure, whey, milk, finely chopped banana stalks, worm humus, cane juice or molasses, finely chopped organic matter, coffee pulp and rock flour. I collect and gather all these materials throughout the year and store them inside, so I can use them whenever I want. This is profitable because almost all materials come from the farm. I calculate that 100 sacks cost me around C$55 each. And if I had to buy them, each sack would cost C$180 each.

PREPARATION OF MINERALIZED COMPOST

Materials required for making approximately 20 quintals:

MATERIALS	Quantity	Observations
Whole or ground rice husk, ground corncobs, ground corn husk, fine chopped grass, coffee husk, dry pulp coffee, powdered cocoa pods, cocoa husk, chaff of imperfect beans, chopped banana stalks, semi-dry fruit pulp, well degraded sawdust, grinded fruit wastes. You can work with what you have available.	4 qq	When made for cocoa or coffee, reduce the amount of rice husks, replace with coffee or cocoa wastes. Add chopped-up banana flowers as compost for coffee.
	10 quintales	
Decomposed or dry manure	10 qq	
Rock flour (2 sacks)	3 - 4 qq	Filter at least half of it through a fine sieve
Coal (1 sack)	40 lb	Finely ground-up
Ash	25 lb	Fine
Leaf litter or decomposed mountain microorganism	75 lb	
Vermicompost	1 quintal	
Semolina	1 quintal	
Molasses	Medium size container	Or honey from 8 bars of brown sugar
Solid bio-minerals	10 lb	If not available, use mountain microorganisms.
Liquid bio-minerals	1 gallon	If not available, replace with whey or half a gallon of milk, sugarcane juice or slurry
Water	100-120 liters	Preferably rain or spring water.
Yeast or corn beer mix	1 lb	Spread over the material

Notes:

1. *Seeds: contain higher concentration of active minerals (Semolina)*
2. *Chaff or husks: contain second highest level of active minerals*
3. *When turned over, the material loses approximately 20-25% moisture content*
4. *Fewer elements can be used in the mixture, but the final product will have less nutrition.*

OAnother important item to keep in mind while preparing for planting is to leave a distance of 2 yards between plants and 2 yards between rows. This gives a density of 2,500 plants per manzana, which allows for several things:

Allows space to perform tasks such as mulching or spraying. For example if the plants are very close to each other, it is difficult to spray the leaves, especially the bottom side of the leaves. However, if coffee plants are distanced from one another, they can be sprayed easily.

Allows for other fruit trees, such as citrus, avocado or cocoa, to be planted as part of the diversification of the plantation.

2. Use Bio minerals spray for plant health.
Besides planting, the other secret is spraying the coffee plantation with bio mineral mixtures every month without missing a single month.

The only time of the year when spraying is not appropriate is during flowering and harvest, so the berries do not acquire an unpleasant taste.

This bio mineral is a concentrated bio-fertilizer spray used to nurture and control diseases on coffee plants.

Bio-mineral Ingredients

- 2 bags of coffee pulp or rice husk
- Half a sack of mountain microorganisms
- 5 liters of milk or whey
- 5 liters of molasses or sugarcane juice
- 5 pounds of rock flour
- 1 or 2 liters of beer or urine
- 3 teaspoons of baking soda
- 1 pound yeast
- 1 bag of semolina

Mountain microorganisms are dry leaf and organic litter in the process of decomposition that are obtained from hedgerows, dead barriers or in drainage ditches.

Preparation
Mix the dry materials, including the mountain microorganisms (soaked the day before to maintain moisture), wetting the mix with the molasses and milk dissolved in water.

This mixture has to be solid, but not too wet, as it should be stored in a barrel and compact, similar to silage.

Next, one fills a barrel with this solid mixture, leaving a 3 inch air chamber at the top and seals it to keep air out while it ferments for one month.

¿How is it used?
For a 200 liter water barrel to spray 1 manzana, use 20 pounds of solid bio mineral. The day before using, put the solid bio mineral that you are going to use in a sack and hang it in the barrel filled with water, as if you were making tea.

The liquid resulting from the overnight soaking is sprayed directly onto the plants.

The results obtained with the use of mineralized and bio-mineral compost ensure that the impact of rust is minimal, has not greater than 4%-5% on farms, and each year there is greater production.

"I started harvesting 10 qq at the 3rd year, this year I hope to harvest 20 qq and a greater production year by year as the plants start developing."

Annex: Products allowed in Organic Agriculture

A. Soil fertilizers and vegetables

- Clay (Betonita, perlite)
- Sawdust, tree bark and wood residues
- Sulfur
- Charcoal
- Wood ashes
- Household waste
- Compost from plant residues
- Organic derivatives of food products
- Animal manure produced in ecological production units
- Liquid manure or urine
- Decomposed Bat Guano
- Vermicompost
- Oligoelements (boron, copper, iron, magnesium, molybdenum, zinc)
- Biological organisms such as bacteria and mycorrhizae
- Straw
- Powdered animal horns and hooves
- Bone powder
- Feather dust
- Limestone
- Blood powder
- Rock flour
- Homeopathic preparations
- Processed animal products from slaughterhouses and fisheries
- Natural phosphate rock
- Aluminum calcin phosphate Rock
- Magnesium rock
- Magnesium limestone rock
- Potassium sulfate
- Whey
- Magnesium sulfate
- Gypsum (calcium sulfate)
- Cocoa shells, free of toxic rresidues
- Sulfer
- Compost containing mushrooms
- Fresh manure
- Micro-nutrients from natural sources
- Zinc or iron sulfates
- Diatoms earth

B. Products for the control of pests and diseases

- Animal and vegetable oils
- Paraffin oil
- Garlic
- Bacillus Thuringiensis
- live barriers
- Sodium bicarbonate
- Carbon dioxide bioxide
- Copper hydroxide
- Copper as copper hydroxide, copper oxide, Bordeaux mixture and tribasic copper sulfate.
- Potassium salt of fatty acids (soft soap) Potassium soaps, sodium or biodegradable detergents
- Rock flour
- Bee glue
- Vegetable extracts
- Pheromones obtained from natural sources used in insect attractant traps
- Bordeaux mixture, 1 kilo of copper sulfate with one kilo of calcium hydroxide in 100 liters of water
- Hydrated lime
- Vegetable oils aids. Must contain at least 90% oil-vegetable and no pesticides.
- Biological control
- Cultural and mechanical controls
- Waste from of sea animals (crab shells, shrimp)
- Humic acids derived from natural sources, having no synthetic aggregates
- Botanical extract of Quassia (Quassia amara)
- Insect extracts
- Seaweed extracts
- Mineral powders
- Sodium silicate
- Tree sealers
- Whey
- Mechanical Traps for rodent control
- Boric acid
- Sulfur
- Lime
- Copper
- Petroleum jellies
- Clorox
- Natural sprays
- Cotton seed flour
- Aminoacid herbidices
- Copper hydroxide
- Polvo de pieles
- Chelating agents
- Rotenone
- Sabadilla
- Magnesium sulfate salt
- Treated seeds, only if natural seeds are not available.
- Potassium sulfate

Certified producers who wish to use external inputs must be authorized by the certifying agency to assess their compatibility for use in organic farming. The process of evaluating takes 3 business days.

SUSTAINABLE GOOD AGRICULTURE PRACTICES MANUAL,

To improve yields of organic coffee and control coffee rust