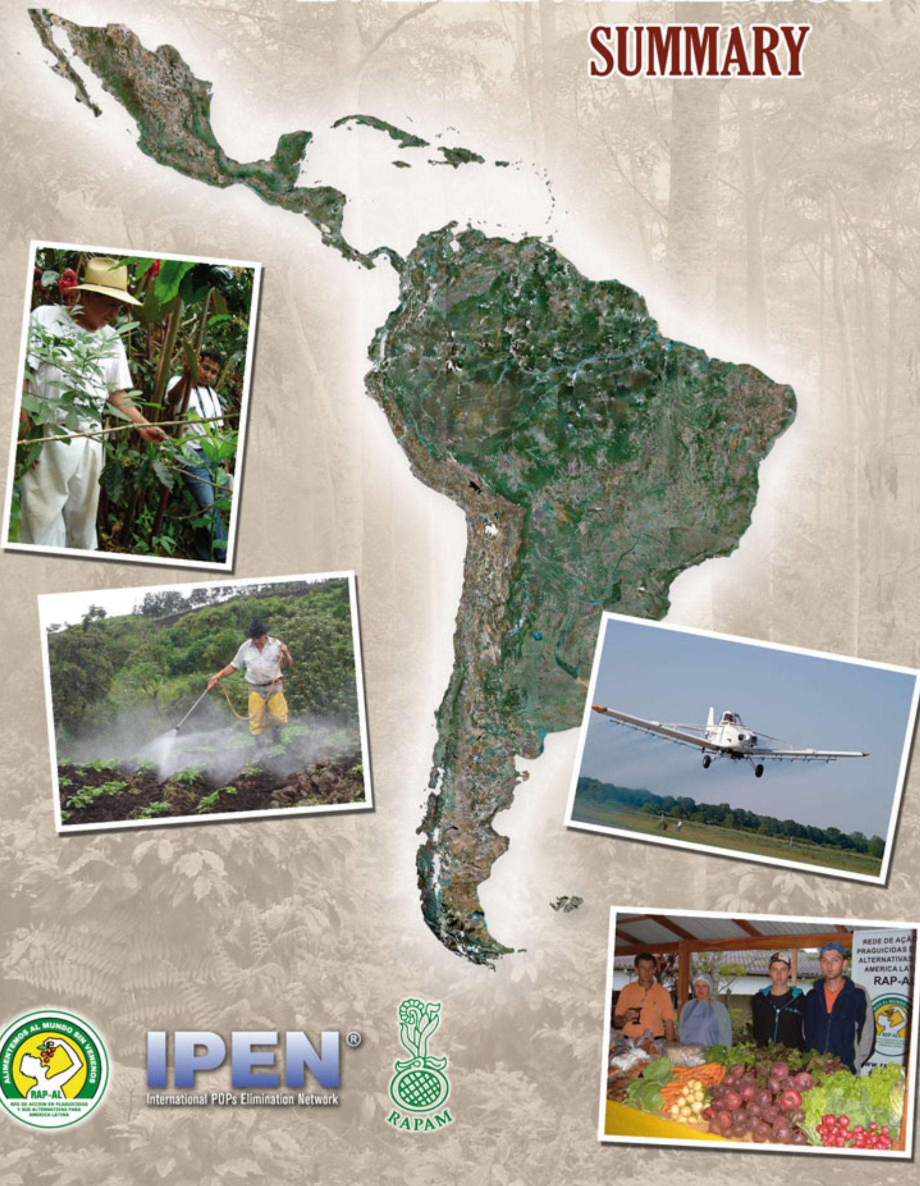
ALTERNATIVES TO ENDOSULFAN IN LATIN AMERICA

SUMMARY



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Alternatives to Endosulfan in Latin America

Summary

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RAP-AL Red de Acción en Plaguicidas y sus Alternativas para America Latina

RAPAM

Thanks to the International Pops Elimination Network (IPEN) and the Pesticide Action Network in Latin America (Red de Acción sobre Plaguicidas y sus Alternativas en América Latina (RAP-AL) for their support .

This a summary from the original report in spanish "El Endosulfan y sus Alternativas en América Latina " Part I and Part II available in the web page.
http://www.rap-al.org/articulos_files/Alternativas_12_Julio.pdf
the II Report will be available soon in the same web page

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Texcoco, Mexico, April 2009
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1. Introduction

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The European Union proposed that endosulfan be included in the Stockholm Convention on Persistent Organic Pollutants, because it is toxic, persistent, bioaccumulative and travels long distances. The Convention Secretariat and the POPs Review Committee accepted the nomination, and as a result, a risk profile and management plan will be developed, with recommendations to be approved by the Convention's Conference of the Parties for the potential world-wide elimination of this substance in the coming years.

Endosulfan has also been proposed for inclusion in the Rotterdam Convention, which applies the principle of Prior Informed Consent (PIC). This would mean in theory that endosulfan could be exported only with prior consent from the importing country.

This booklet is a summary of the report entitled El Endosulfán y sus Alternativas en América Latina I y II (Endosulfan and its Alternatives in Latin America I and II), written by members of the Action Network on Pesticides and their Alternatives in Latin America (Red de Acción sobre Plaguicidas y sus Alternativas en América Latina—RAP-AL). The report illustrates the variety of alternatives to endosulfan beyond the chemical substitution approach that means go beyond chemical pesticides that are less toxic and less persistent, but also agroecological and organic agricultural practices used in growing soybeans, coffee, vegetables, flowers and tobacco in Latin American countries.

Restrictions and prohibition of endosulfan around the world

To date there are 60 countries that have banned the use of endosulfan, and these include the European Union. In Latin America endosulfan is prohibited in Colombia, and recently Venezuela has not renewed its registration for agricultural use of endosulfan in 2009. Federal authorities in Brazil and Uruguay are also assessing the possible cancellation or severe restriction in the use of endosulfan. The state of Rio de Janeiro has proposed banning the use of endosulfan in its territory, due to contamination caused by the spilling of this pesticide into the Paraiba do Sul River in November 2008.

There are a number of restrictions on endosulfan use in Central American countries. In Honduras (1991) and Panama (1992) it may only be used against the coffee berry borer, and with a minimum 30-day waiting period between application and harvest in Panama. In El Salvador (2004) it cannot be applied within 20 meters of water sources or used in gardening, and aerial application is prohibited. In Costa Rica its use is prohibited in rice growing (2008), and its aerial application is also banned.

Alternatives to endosulfan in different countries

The fact that endosulfan use has been banned in numerous countries and crops demonstrates that it can be replaced with other alternatives. The growth of organic agriculture, agroecological control practices and integrated pest management around the world demonstrates that it is technically possible to move beyond simply substituting endosulfan with other chemical pesticides. Therefore, in the evaluation of risk management by governments and by the POPs Review Committee, it is important that not only chemical substitutes be considered but also agroecological alternatives that avoid and prevent risks and the use of this POP.

In 2008 Germany's Pesticide Action Network (PAN) published a field guide for producing a great variety of crops in the tropics without using endosulfan. These crops include cotton, vegetables, coffee, fruit, peanuts, tea, oil crops and yucca. The guide describes non-chemical methods for controlling pests, including cultural and physical controls, the use of beneficial insects in biological control, and the homemade preparation of insecticides and repellents, using various plants and seeds. The guide is part of the Online Information Service for Non-chemical Pest Management in the Tropics (OISAT). RAPAL-Cuba is working on a similar manual for tropical crops in Latin America.

2. Alternatives in Argentina

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Argentina is one of the world's countries with the greatest amount of land used for growing certified organic crops. In 2006 there were 2,656,559 hectares of certified organic production, organized into 1,486 agricultural units in 2007. There are also many agricultural units producing organically, but without certification due to the costs involved and the rejection by producers of what they consider to be imposed certification. It is difficult to estimate the amount of land used for certain types of organic crops and in certain areas, such as horticulture activities in the Buenos Aires province, however land dedicated to non-certified organic crops may be twice as extensive as the land used for certified organic crops.

Over 95% of organic food production in Argentina is destined for exportation, and in the case of oilseeds, 77% is exported to the European Union, 22% to the United States and the remaining 1% to Switzerland.

Some elements in the ecological management of soybeans in organic production include preparing the soil by tilling twice; planting disease-resistant seeds; adequate inoculation and density; application of biofertilizers that increase natural fertility, stimulate beneficial microorganisms and increase the crop's resistance; and insect management with interspersed multiple crops. For example it is recommended that soybeans be planted in strips, interspersed with strips of corn, thereby achieving better use of soil and solar energy, and reducing the incidence of insects and disease. Some techniques used in organic soybean growing include not clearing weeds from the ends of crop rows, since these areas serve as host habitats for predatory insects and pest parasites, or using only selective weeding in the land plot to leave trap plants for harmful organisms.

There are chemical alternatives to endosulfan, specifically pesticides with less severe toxicity, which should be used with an appropriate management plan and not in an isolated manner. In addition it is necessary to implement an appropriate system for controlling the distribution, commercialization and use of these products. In particular this last stage requires ongoing monitoring of the environmental and social conditions in which such alternatives are applied, and epidemiological studies of the exposed population.

For most crops it is recommended that endosulfan not be replaced with other chemical pesticides, but rather that conventional production methods be replaced with other methods based on agroecological principles, with appropriate soil nutrition, biodiversity and ecological pest management.

3. Alternatives to endosulfan in Bolivia

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In the 1990s, specifically in the Sud Yungas Region (Chulumani and Irupana), the QHANA Popular Education Center was the first to experiment with controlling the coffee berry borer by multiplying and releasing the parasitic wasp *Cephalonomia stephanotheris*. The wasp was imported from Colombia, and its reproduction initially took place in greenhouses set up for this activity. The technique was later transferred to peasants receiving training in laboratory procedures.

The reason that community laboratories are used is because they are stably located at key sites in the region, and because of the need to collect infested coffee berries, and carry out other follow-up tasks in maintaining crops, and managing temperature control, humidity, among other activities.

Another biological control measure that is effective against the coffee berry borer is the application of the entomopathogenic fungus *Beauveria bassiana*, generally from laboratories established in communities. The *Beauveria bassiana* is a fungus that has proven to be promising in this type of biological control, particularly in humid areas. This fungus is found naturally where the coffee berry borer is found. A number of field studies (especially in Colombia) have demonstrated that the natural levels of *Beauveria bassiana* can eliminate up to 80% of adult coffee berry borers, when they attack young berries. This means this fungus is an important factor in eliminating the coffee berry borer in continuous humid climate conditions (which is the case in Los Yungas in Bolivia).

The implementation of improved coffee varieties is consolidated through Farmers' Agricultural Corporations (Corporaciones Agropecuarias Campesinas--CORACAs), which tend to produce organic export coffee, through the management of species resistant to the coffee berry borer, as one of the requirements for certification of their products.

Cultural pest control includes measures such as appropriate harvest practices in which coffee berries are not allowed to become over-ripe and fall to the ground, by picking up the berries that do fall to the ground to prevent their possible infestation, and by selecting the bad (or diseased) berries to be eliminated from the harvested beans.

4. Alternatives in Brazil

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There are a number of alternatives to using endosulfan in Brazil, ranging from switching to using products with less toxicity, to using integrated pest management, as well as practices and products already being used by the country's organic agricultural producers.

Brazil is one of the world's countries with the most highly-developed organic agriculture, with an estimated area of 6.5 million hectares available for growing organic crops such as bananas, pineapple, coffee, honey, milk, meat, soybeans, palmito, sugar, chicken, vegetables and some Amazonian products such as chestnuts, açaí, latex and fruit. In recent years there has been notable development in organic agriculture in Brazil, with an average annual growth rate of 20-25%. Small family agricultural producers represent more than 80%

of the 20,000 organic producers, involved primarily in vegetable production. There is a large movement involved in seeking biological organisms and natural methods for controlling pests and diseases in general. The crops in which biological control practices are currently spreading include: soybeans, corn, sugar cane, cotton, rice, wheat, citric fruits, fruits in general, forestry plantations and fodder. There is a tendency toward these practices becoming more widespread in use, in association with integrated pest management (see www.embrapa.br).

Use of chemical pesticides other than endosulfan. When the use of pesticides in soybean growing is inevitable, Secretary of Agriculture authorities recommend the use of selective insecticides, in this case products that efficiently control pests but are allegedly less toxic to natural enemies, generally piretroids. These active ingredients are listed in the tables of recommendations from Brazil's Regional Commissions for Soybean Research.

The use of broad-spectrum chemical pesticides in the initial phase of crop development provokes population imbalances between pests and their natural enemies, thus creating what is referred to as a "biological desert." The initial damaging symptoms of this inappropriate management system are expressed through the reappearance of soybean caterpillars in crops. This is because when natural enemies are eliminated, the pest re-establishes itself much more quickly and intensively.

Alongside the re-emergence of the soybean caterpillar, there have been explosions in the populations of other caterpillar species that were previously considered only of secondary importance, such as the soybean looper moth and those that attack the soybean pods. These pests are normally maintained at low population levels in soybean fields, due to the action of efficient natural enemies. In the absence of such beneficial agents, the pests reach population levels that can result in significant losses in crop productivity, and in addition, they are typically difficult to control. The inappropriate use of insecticides in the soybean's vegetative phase provokes negative effects in pest management during the reproductive phase. This occurs because these products can affect the establishment of natural enemies that attack true bugs, especially wasps that parasitize their eggs.

It is important to assess the effect on natural enemies from the planting of the RR transgenic soybean, resistant to the Roundup Ready glyphosate herbicide, especially in relation to the fungi that cause diseases in insects (www.cnpma.embrapa.br/).

Integrated pest management, when correctly implemented in soybean fields, provides economic, ecological and social benefits for producers and society. This technology is based on a set of tactics and on the fundamental principle of natural biological control of pests—carried out by predators, parasitoids and pathogens. These beneficial organisms, which are collectively referred to as natural enemies of soybean pests, are actually the natural friends of soybean producers, because they maintain pests below population levels that would cause damage to crops. In this way, it is possible to reduce the number of times insecticides are applied in the fields and consequently, to reduce production costs.

The main insect predators found in soybeans are bumble-bees (*Callida* sp., *Lebia concinna* and *Calosoma granulatum*), chinch bugs (*Orius* sp., *Tropiconabis* sp., *Geocoris* sp. and Podisus sp.) and spiders. The individuals in this group of natural enemies are characterized by feeding on various insects during their lifetimes, thereby constituting important natural control agents. In the case of the *C. granulatum* predator, both the adult (bumble-bee) and the younger form (larvae) feed on caterpillars, and can eat more than 90 small caterpillars in a single day.

Among the parasitoids, the most common species are flies (Diptera) and wasps (*Hymenoptera*). Female parasitoids lay their eggs inside caterpillars and chinch bugs, and can also lay them on their backs. The parasitized pest-insect dies during or after the emergence of the adult from the parasitoid and in this way the parasitism cycle begins again. Both the soybean caterpillar (*Anticarsia gemmatalis*) and soybean looper moth (*Pseudoplusia includens*), which are considered to be the main soybean defoliators, suffer from the actions of parasitoids, which can maintain these populations at reduced levels in fields. The true bugs in soybeans (*Euschistus heros, Piezodorus guildinii* and *Nezara viridula*) are subject to attack by parasitoids in their three phases of development (egg, nymph, adult). The eggs are normally parasitized by the *Trissolcus basalis* and/or *Telenomus podisi* wasps, while the adults are parasitized by the *Trichopoda nitens* fly and by the *Hexacladia smithii* wasp. In soybean fields in Mato Grosso do Sul, where no chemical insecticides are used, over 80% of E. Heros chinch eggs were parasitized by *Telenomus podisi* wasps. In addition, a large number of pathogens are found in the soybean ecosystem, and they attack pests from the time crops are planted to their maturation.

The government should support all alternative forms of "pest" control, with emphasis on biological control, with the objective of recuperating ecological balance, which will in turn make it possible to reduce the incidence of insect populations that damage crops. With all the experience accumulated by producers and organizations in the area of organic production, there are a number of possibilities for biological control of "pests." In addition, there are other chemical products less toxic than endosulfan that can be used as a last resort when necessary.

5. Alternatives in Costa Rica

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The main alternatives to the use of endosulfan have been implemented in crops such as coffee, where the entomopathogenic fungus *Beauveria bassiana* has been used to control the coffee berry borer. Also, the use of the parasitoid wasp Phymastichus coffea provided positive results in controlling coffee berry borer larvae, however the production and release program was discontinued.

Cultural practices used in coffee growing consist of: collecting infested coffee beans, including those that have fallen to the ground and those still on the plants after harvesting. Where there is a high incidence of this pest, infested green berries are collected before the harvest.

In other crops *Bacillus thuringiensis* has been used to control lepidoptera larvae. And the spinosad insecticide is used in broccoli, cabbage and pineapple. The latter is a natural insecticide produced through the fermentation of an actinomycete bacteria called *Saccharopolyspora spinosa*.

In 2007 in Costa Rica there were approximately 8,000 hectares of agricultural crops with organic agriculture certification, with no use of chemical fertilizers and pesticides. There were 1,713 hectares of coffee, 482 hectares of pineapple, 85 hectares of vegetables, and 55 hectares of rice. Support programs for organic crops should be strengthened.

6. Alternatives in Cuba

Nilda Pérez Consuegra.
CEASE. RAPAL Cuba

Endosulfan is authorized for agricultural use in 11 crops, for controlling lepidopteras, thrips, white flies, leaf beetles and coffee berry borers, in coffee, garlic, onion, cucurbits, forest products, bean, potato, tomato, pepper and tobacco growing.

Cuba has considerable experience in the production and use of biological control agents. The current national program for biological control was initiated in the 1980s, and at that time, the production of different entomophagos began in the Centers for Reproduction of Entomophagos and Entomopathogens (Centros de Reproducción de Entomófagos y Entomopatógenos—CREE). The *Trichogramma* wasp is the parasitoid that is produced and released in the largest quantities in Cuba. It is produced in 77 CREEs distributed in 14 provinces. The total annual production amounts to over 16 million wasps, used in approximately 700,000 hectares of cropland (Massó, 2007). This means that national coverage is guaranteed. This wasp has been used as a parasitoid for lepidoptera eggs in tomato, pepper, cucurbits and tobacco fields. Other parasitoids used are the *Telenomus* spp. and *E. plathyhypenae*, which were included in the integral management program for corn moths and in the phytosanitary strategy in some of the provinces for controlling lepidopteras in pepper, tomato, garlic and onion growing.

Other parasitoids used are the *Tetrastichus howardi Ollif* and *Tetrastichus* spp. for controlling lepidoptera insects in potato, tomato, pepper, cucurbits, garlic and onion fields. Currently they are produced in 29 CREEs distributed in nine of Cuba's 14 provinces.

Bacilo thuringiensis is the entomopathogen that is used the most and has been produced the most in Cuba. It is produced at both low-scale and industrial levels, and the latter is through biopreparation facilities, of which there are four operating in Cuba. Three of the four have capacity to produce 120 tons per year. *B. Thuringiensis* is used for controlling lepidopteras in tomato, pepper, potato, cucurbits, beans, garlic, onion, tobacco and forestry products.

In terms of the use of entomopathogenic fungus, especially worth noting is the Beauveria with its primary species: *B. bassiana* (Balsamo) Vuillemin; *B. brongniartii* (Saccardo) Petch and *B. amorpha* Samson & Evans. These species are very effective in controlling numerous insects and are among those having the greatest range of hosts.

The report also emphasizes non-chemical alternatives to the use of endosulfan for controlling coffee berry borers, white flies, bean leafhoppers and thrips.

7. Alternatives in Chile

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Endosulfan was introduced in Chile in the 1950s and used intensively against a broad spectrum of insects and mites in agriculture, floriculture and ornamental plants, and as a wood preservative.

Magazines on gardening and specialized gardens have frequently recommended the use of endosulfan to control pests when growing flowers and ornamental plants. However, small producers of greenhouse flowers have been decreasing their use of endosulfan primarily because of three important factors: endosulfan should only be used in well-ventilated areas, while flower growing takes place primarily in greenhouses; endosulfan has a minimum 24-hour re-entry interval and a long waiting period before re-application of between 1-24 days, depending on the crop; and endosulfan is toxic when inhaled, ingested or absorbed through the skin.

The application of organic agriculture methods in floriculture is based on principles of ecological soil management; ecological management of pests, diseases and weeds; management of local biodiversity; and establishing and increasing natural biological control.

Plant health is managed primarily on the basis of the notion that "well-nourished plants are healthier and more resistant." The following elements are important in achieving this objective: plant and animal-based fertilizers should be used at the foliar level for the purpose of nourishing the plants, but they should also serve as repellents, fungicides, etc., thereby increasing the plants' natural resistance. Some examples of these fertilizers are: fermented mixtures based on plants such as stinging nettles; mixtures based on inputs of animal origin and others based on fermented compost, bocashi, humus, etc., or based on fermented cow manure enriched with mineral salts, for example.

The Flower-Growing Management Plan describes the main problems in detail, and for each of them, specifies natural enemies, preventative measures, and direct alternative measures and inputs. For example, for controlling pests and diseases, the recommended preventative measures are: using plants as barrier repellents; establishing species such as calendula, and basil-thyme-tagete; improving barriers of flowers or aromatic plants both inside and outside of greenhouses or fields; improving level of organic material in soil; introducing bio-inputs through irrigation system; and introducing foliar bio-inputs. And recommendations for direct alternative measures include frequently using (2 to 4 times a week, depending on season) the following bio-inputs on plants and soil: compost, bocashi and/or fermented plant mixtures, and garlic concentrate, since it has broad-spectrum effectiveness.

8. Alternatives to endosulfan in Mexico

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Fernando Bejarano (RAPAM)

One of the crops in Mexico in which it has been proven that there are alternatives to endosulfan is coffee. Large amounts of endosulfan have been used historically in growing this crop, although the use of this insecticide has been diminished as a result of the expansion of organic agriculture and alternative management practices, and the promotion of integral control through Mexican Official Standard NOM-002-FITO-2000. Currently, the use of endosulfan is restricted, due to government campaigns launched by Plant Health authorities, for quarantine purposes.

At the international level Mexico was a pioneer in organic coffee growing and in fair trade, developed successfully by producer organizations at their own initiative, and as a response to the crisis in conventional coffee growing. The amount of land and the number of organizations involved have been increasing each year. The calculation for 2005 was a total of 123,000 producers in organic coffee growing, and between 80,000 and 90,000 of them belonged to over 400 organizations, most of them rural and indigenous. The total land area was 147,000 hectares, representing 19% of the total land area used to grow coffee in Mexico, and by 2008 this amount had increased to 25%. Coffee is shade grown in over 90% of Mexico's coffee plantations (Gómez 2007 and 2008).

There are only a few cases of an agro-chemical so closely associated with a specific pest as the link between endosulfan and the coffee berry borer. This close association is well known in nearly all the world's coffee-producing countries and has generated a large amount of scientific research as well as a variety of programs for finding an alternative to fight this particular pest. The coffee berry borer (*Hypothenemus hampei*) is a tiny beetle (no more than 2 mm in length) from the *Scolytidae* family and is originally from Equatorial Africa. It has been introduced and gradually expanded in nearly all coffee-producing countries. In Mexico it was registered in the Soconusco region in the state of Chiapas in 1978 (Baker 1984), and since then has become the main pest in Mexican coffee fields, affecting both yields and cup quality. As soon as the pest appeared, the use of chemicals to fight it began, however its resistance to endosulfan was detected within only a few years (Brun and Ruiz 1987). This was one of the factors making it necessary to seek alternative control methods not based on agro-chemicals. As an insect pest, the coffee berry borer has a particular characteristic that makes its eradication more difficult: the female adult that bores tunnels in the coffee berry and lays her eggs in them, and the resulting larvae that feed on the coffee bean's endosperm, have very little outside contact.

The alternatives for controlling the coffee berry borer in Mexico have consisted in the following:

a) Biological control. The coffee berry borer has diverse natural enemies, and especially worth mentioning among those used to fight this pest are entomopathogenic fungi, especially *Beauveria bassiana*. The use of the latter has been standardized in Mexico's primary coffee-growing regions through laboratories set up for producing the spores and the use of both native and introduced strains.
b) Wasps have also been used in Mexico, particularly in the state of Chiapas. The ones used there are *Cephalonomia stephanoderis*, *Prorops nasuta* and *Phymastichus coffea*, however only the first has been used widely as a biological control method par excellence due to its capacity to establish itself. *P. coffea* is a parasitoid that attacks the coffee berry borer in its adult stage, outside the coffee berry, and is thus an important complement to agroecological management during the growing cycle.
c) Ethological control. Traps for coffee berry borers are used in the inter-harvest period. The traps contain ethyl or methyl alcohol that serves to attract the borers during flight. Plastic bottles (two or three-liter size) are used to make the traps.
d) Manual control. This method is based on manually picking the dried berries off the plant and those that have fallen to the ground. This is referred to as "sanitary harvesting" and is aimed at interrupting the insects' cycle. It is carried out during and immediately after harvesting. The dried berries collected should be buried, burned or, if they will be consumed, boiled for ten minutes.
e) Other complementary forms of control, including: the use of botanic or natural insecticides or bioinsecticides such as Neem (*Azadirachta indica*), which are beginning to be used as alternatives to chemical insecticides; cultural control as mentioned in the following section; and

f) Legal control with the quarantines established in accordance with the Mexican Official Standard for the Campaign against the Coffee Berry Borer (NOM-002-FITO-2000). It is important to note that this official standard includes recommendations for using traps, cultural control (pruning, shade regulation, weed elimination), biological control and chemical control.

In the area of organic production, ethological control is being used in the Putla, Oaxaca region, promoted by the Plant Health Office in Mexico's Secretary of Agriculture. Producers comment that the bottles should be refilled with fresh alcohol frequently, every two weeks, and they report that this method is better than applying the Beauveria bassiana fungus and allows them to observe a large number of these borers.

In the central Veracruz region approximately ten years of experience have been accumulated through the Community Modules for Supporting the Transfer of Coffee Technology (Módulos Comunitarios de Apoyo a la Transferencia de Tecnología en Café—MOCATTs), promoted by the National institute of Forestry, Agriculture and Fishery Research (Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias—INIFAP) in the Tlacotepec de Mejía and Totutla municipalities. The groups working in these Modules use a cultural control method based on cleaning coffee fields, shade regulation, an adequate level of fertilization (whether chemical or organic), and different pruning methods for maintaining a good level of productive material. In addition to this type of control, they also collect remnant berries during and after harvesting. With these two methods, these groups have maintained the infestation levels in their coffee fields at between 5 and 10%, and it has not been necessary to apply any insecticides or even use Hampei traps.

The successful experience in using alternatives to control the coffee berry borer may lead to projects for cooperation and the exchanging of experiences among coffee producers' organizations and governments in Latin America, especially in Central America and the Caribbean. This can serve to support the measures for eliminating the use of endosulfan specified in the Stockholm Convention on Persistent Organic Pollutants.

Lastly, it is important to take into consideration that endosulfan has been included in the list of pesticides banned by the Sustainable Agriculture Network, to be eliminated progressively over a period of three years (by June 30, 2011). This elimination is one of the requirements for obtaining Rainforest Alliance certification for crops such as coffee (RAS July 2008). This is not an organic certification, however it includes integral crop management and is important because of the seven-year assistance granted by the Global Environment Facility (GEF) to Rainforest Alliance at the end of 2005. The purpose of the donation granted through the United Nations Development Program (UNDP) is to certify 10% of the world's coffee supply, beginning with Guatemala, El Salvador, Honduras, Colombia, Peru and Brazil (Rainforest Alliance 2008). It can be expected, therefore, that the number of plantations in Latin America eliminating the use of endosulfan will increase in the coming years.

9. Alternatives to endosulfan in Paraguay

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ALTERVIDA

Alternatives to the use of endosulfan in flower-growing can be illustrated with examples from two areas of Paraguay. One is the Itaugua Guazú area, located in the Itaugua District, in the Centra Department, and the other is the Yaguarón District, located approximately 50 kilometers southeast of the country's capital. The primary insect pests in Paraguay's flower-growing activities are aphids, mites and thrips, and endosulfan has only been used to control the latter.

The methods that have been used successfully to control these pests in vegetable-growing and are now being used in flower-growing are a variety of preparations made with plants having insecticide properties. The main ones used are: a) Paraíso Preparation made with *Melia azederach*, for controlling white flies. This ingredient is the one most widely used in the country, due to its availability throughout the entire national territory, its high efficiency and easy preparation. There are a number of preparations with varying combinations. b) Guembé Preparation made with *Philodendron bipinnatifidum* and *Philodendron guembe*, to be used in controlling various insects, including thrips. This product is very efficient used on its own or in combination with other preparations. It is important to handle this preparation carefully, because it causes skin irritation. And it should not be applied fewer than 15 to 20 days before harvesting. c) Pipi Preparation made with *Petiveria alliacea*, used to control white flies, chinch bugs and others. This preparation is very efficient, and it has a strong characteristic odor that serves as a repellent, according to some agroecological producers. It is best to not apply this preparation on flowers or crops about to be harvested.

10. Alternatives in Uruguay

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RAPALUY

Important changes have been developing in Uruguay's agricultural sector since the beginning of this millennium, linked to the explosive introduction of soybean production and also a new surge in forestry production. Concern over the use of chemical products, particularly endosulfan, is based on a highly significant increase in the total land area dedicated to soybean growing in Uruguay, with an increase from 18,000 hectares in 2001, to over 300,000 hectares in 2006.

Experts from the Organic Producers Association of Uruguay (Asociación de Productores Orgánicos del Uruguay—APODU), maintains that it is possible to produce vegetables without using chemical products. The emphasis is on a global strategy that involves applying cultural and biological measures and others that restore and maintain ecosystem balance in production systems. Measures especially worth mentioning here are: increasing biodiversity, using appropriate locally-produced varieties, rotating vegetables grown (taking into account that vegetables are hosts to different types of pests), adequately managing densities, using biofertilizers, and when necessary, also using biopreparations for controlling pests.

APODU is the only organic agriculture organization in Uruguay and has approximately 250 producers working in about 150 enterprises, with most having land plots of less than ten hectares. The organization's members work in horticulture, beekeeping, dairy milk production, aromatic herbs and medicinal plants. They have their own channels for marketing their products and have established agreements with many different institutions.

There are various experiences in agroecological production in Uruguay, and all of them are valid. Each producer adopts measures that correspond to each particular production system. What is important to emphasize here is that it is possible to produce vegetables without using endosulfan in these productions systems that have an ecosystem focus. The measures used are economically viable and producing food in this way is viable. It is important to think not only in terms of economic viability, but also environmental, social and cultural viability.