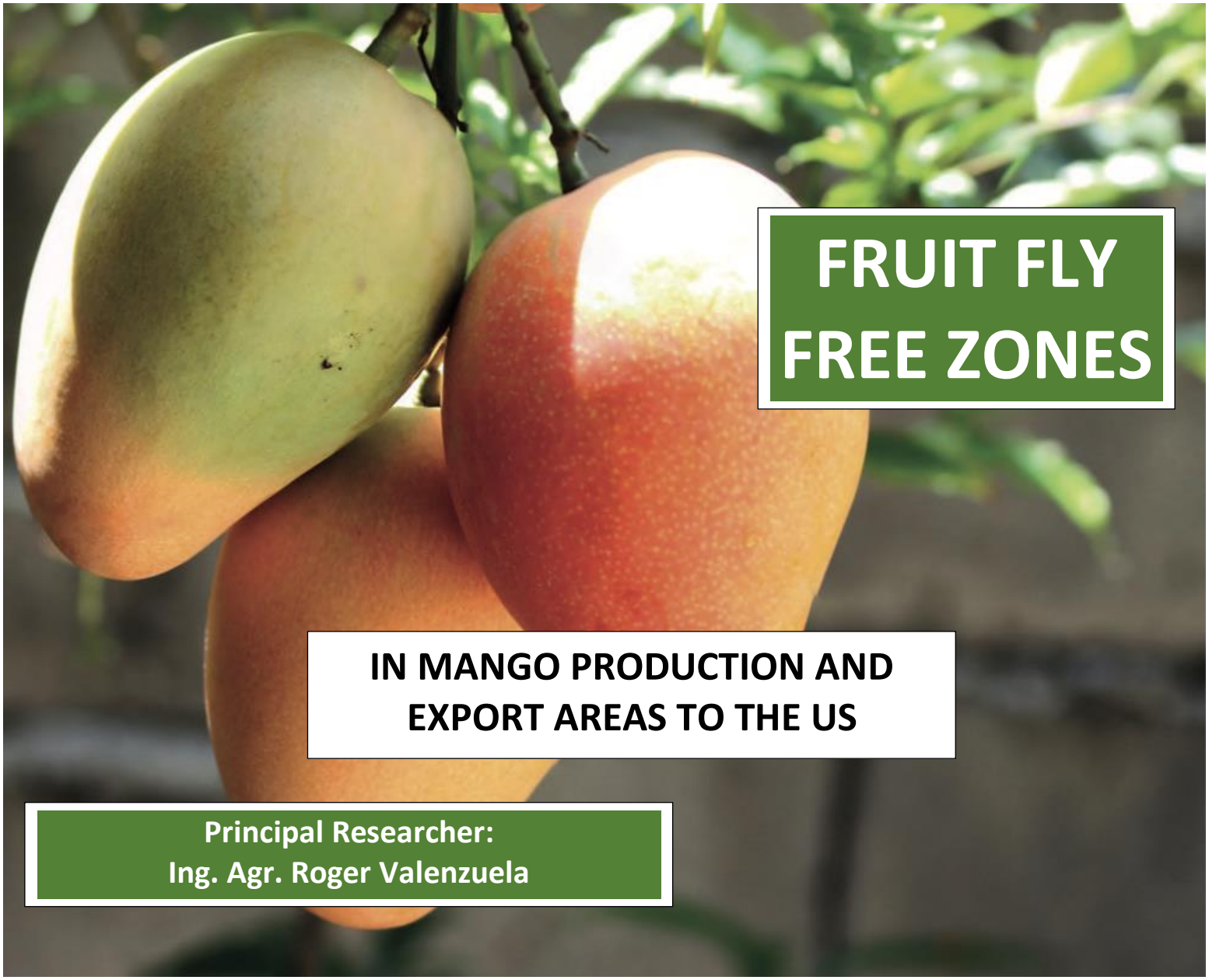

FRUIT FLY FREE ZONES

IN MANGO PRODUCTION AND EXPORT AREAS TO THE US

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The largest exporters of mangos to the US are Mexico, Guatemala, Ecuador, Peru, and Brazil, since these countries possess soil and climate conditions, experience, and suitable technology to produce and export high quality fresh mangos to the US. Nevertheless, to avoid any risk of infestation with fruit flies, currently, an average of 450,000 metric tons that are exported to the US each year are required to undergo a quarantine hot water treatment, however, according to consumer opinion, the quality level of the fresh mangos that are exported declines.

The world trade organization (WTO) is the international organization that focuses on standards that regulate trade between countries, establishing the Agreement on the Application of Health and Phytosanitary Measures, as well as in the International Standards for Phytosanitary Management (NIMF) framework. To improve the quality of mangos that are exported to the US, the fruit needs to be produced in areas that are officially declared and recognized by the USDA (US Department of Agriculture), as areas that are free of any presence of fruit flies.

The five countries that are the subject of this research have their own established national fruit fly control and eradication programs (MOSCAFRUT), therefore, they possess the institutional knowledge and experience to establish and maintain areas with this phytosanitary status, that is, fruit fly free zones.

Currently, 13.5% of the total volume of mangos exported to the US each year is produced only on 5,680 ha, which is equivalent to 69,893 metric tons annually, that come from fruit fly free zones located in the state of Sinaloa, Mexico. These areas have USDA international recognition.

In the remaining 60,173 ha of mango production, distributed among the countries of Mexico, Guatemala, Ecuador, Peru, and Brazil, the production is approximately 450,000 metric tons per year, equivalent to 86.5% of mango exports to the US.

The aforementioned areas exhibit different levels of fruit fly infestation which, in addition to the significantly harmful economic impact that they have on production (20–30%), also pose quarantine barriers since, as previously indicated, in order to export a mango to the US it must be subjected to a mandatory application of a quarantine hot water treatment (Immersion of the fruit in hot water).

Both factors, direct economic damage to production and the economic cost of the quarantine hot water treatment for exports, for a mango production area of 60,173 ha, represent a total annual economic loss of $128.9 million for mango growers and exporters in Mexico, Guatemala, Ecuador, Peru, and Brazil.

For this reason, the National Mango Board (NMB) commissioned a research project in 2021 entitled "***Identification of mango production areas with potential to be declared fruit fly free zones or farms with low fruit fly prevalence in the five main mango producing countries that export to the US.***"

Mango producers, marketers, and exporters to the US, along with other regional organizations related to agricultural health and trade, understand that fruit flies are the

The fruit fly (Anastrepha oblicua) is the specific pest for this crop, nevertheless other pests from this species, that are a part of the Tephritidae family, I've also been observed to affect the mango crop, among which we can mainly include: the Mediterranean fruit fly (Ceratitis capitata), Citrus fly (Anastrepha ludens), Zapote fly (Anastrepha serpentina), Guava fly (Anastrepha estriata), and South American fruit fly (Anastrepha fraterculus).

Of the total mango production area in the five countries, 334,685 ha in total, the research project identified 90,000 hectares (27%) with a high potential to be established as fruit fly free zones. These areas currently produce and export mangos to different destinations. Of these potential areas that have been identified, 65,853 ha (73%) are producing and exporting mangos to the US. The National Mango Board (NMB) believes it is timely and necessary to expand mango exports to the US that are sourced from fruit fly free zones. Reaching this goal implies supporting the execution of a regional strategic plan through which we can strengthen the activities of national phytosanitary protection organizations through public-private partnerships and support the institutional framework of regional and national fruit fly control and eradication programs for the mango crop.

Given that there are already proven solutions for the technical framework at the international level, the recommendation is for the countries of Mexico, Guatemala, Ecuador, Peru, and Brazil --through their respective ministries and departments of agriculture and national phytosanitary protection organizations (NPPO)-- along with the support of exporter associations, the National Mango Board (NMB), OIRSA, FAO, AIEA and corresponding international organizations, to implement the strategic plan for the "ESTABLISHMENT AND RECOGNITION OF FRUIT FLY FREE ZONES FOR MANGO (Mangifera indica) PRODUCTION AND EXPORT AREAS FROM THE AMERICAS TO THE US" for the 2022–2036 period (15 years). This mechanism will allow for the execution of projects and actions that will contribute to the development and expansion of mango exports through the establishment, declaration, and recognition of these fruit fly free zones by the USDA.

The proposed strategic plan would be executed over the course of three 5-year phases until all the potential 90,000 ha that have been identified can be covered (30,000 ha per each 5-year phase). The first two phases would provide coverage for 60,000 ha, which is the approximate mango production area that is currently exporting product to the US.

Within a timeframe of no more than 5 years,
the implementation and execution of the first phase of the ALMA-MANGO Strategic Plan will allow the United States of America to import a minimum of 250,000 metric tons of mangos on a yearly basis, during every month of the year and without the mandatory hot water treatment, from an additional 30,000 ha of mango fruit fly free zones in Mexico, Guatemala, Ecuador, Peru, and Brazil.

EXECUTIVE SUMMARY

The National Mango Board (NMB) commissioned a research project in 2021 entitled "***Identification of mango production areas with potential to be declared fruit fly free zones or farms with low fruit fly prevalence in the five main mango producing countries that export to the US.***"

At a regional level, the results of the research identified 90,000 ha (27% of the total production area) of mango farms with a high potential to be established as fruit fly free zones by the respective ministries of agriculture and recognized by the US Department of Agriculture (USDA).

Figure 1 and Table 1 show the identified locations in greater detail.

TABLE 1:

AREAS WITH THE HIGHEST POTENTIAL FOR THE ESTABLISHMENT OF FRUIT FLY FREE ZONES FOR MANGO PRODUCTION. YEAR 2021

No.	COUNTRY	LOCATIONS: States, Departments, Provinces, Municipalities, Cantons	POTENTIAL AREA FOR MANGO (Has)
1	Mexico	**1°. STATE OF SINALOA**	25,000
		Municipalities:	
		Cosala, San Ignacio, Mazatlán, Concordia,	
		Rosario, Escuinapa.	
2	GUATEMALA	**1° DEPARTMENTS OF RETALHULEU Y**	4,000
		SUCHITEPEQUEZ	
		Municipalities:	
		Retalhuleu, Champerico & La Máquina	
		2° DEPARTAMENTS OF DEL PROGRESO &	1,000
		ZACAPA.	
		Municipalities:	
		El jícaro, Huite, Río Hondo, Estanzuela.	
		Subtotal	**5,000**
3	ECUADOR	**1° PROVINCE OF GUAYAS**	5,000
		Parishes and Cantons:	
		El Chongón, El Consuelo, El Empalme, &	
		Palestina.	
4	PERU	**1° Departaments of Piura, Lambayeque,**	30,000
		& Ancash	
		Valle de San Lorenzo:	
		Tambogrande, Sullana.	
5	BRAZIL	**1°. STATES OF PERNAMBUCO & BAHIA.**	25,000
		Eje Petrolina-Juazeiro.	
		(Valle del río San Francisco)	
		Municipalities:	
		Petrolina, Santa María de Buena Vista,	
		Belén de San Francisco, Lago Grande,	
		Orocó, Casa Nova, sobradinho, Juazeiro, &	
		Curacá.	
		TOTAL	**90,000**

SOURCE: Prepared by the researchers based on data collected from the various departments of fruit farming and MOSCAFRUT.

FIGURE 1:

POTENTIAL AREAS FOR THE DECLARATION OF FRUIT FLY FREE ZONES. YEAR 2021

SOURCE: Prepared by the researchers based on data collected from the various departments of fruit farming and MOSCAFRUT.

In the specific case of Mexico, it currently has 5,680 ha that are recognized by the USDA as fruit fly free zones for the species: Ceratitis capitata, Anastrepha oblicua, Anastrepha ludens, Anastrepha serpentina, and Anastrepha striata. These areas are located in the municipalities of Ahome, Choix, El Fuerte, Guasave, and Sinaloa de Leyva, in the state of Sinaloa, from which they export 69,893 metric tons to the US without the need for the application of the hot water treatment.

Additionally, in the state of Sinaloa there are seven other municipalities: Mocorito, Angostura, Salvador Alvarado, Badiraguato, Culiacán, Navolato and Elota, that also have international recognition by the USDA as fruit fly free zones and where there are around 1000 ha planted with mangos that eventually could increase the mango volume that is exported to the US without the need for the application of the hot water treatment.

In the southern part of the state of Sinaloa there are approximately 25,000 ha planted with mangos that are distributed among the municipalities of Cosalá, San Ignacio, Mazatlán, Concordia, Rosario and Escuinapa that have been established by the Ministry of Agriculture as areas of low prevalence of fruit fly and, continuing with the north-south control and eradication pest strategy, these are the areas being proposed for the study, as well as the potential and priority areas, to be able to establish fruit fly free zones.

Guatemala has the greatest potential to export mangos to the US without the need for the application of the hot water treatment, specifically during the months of February through May, due to its geographical location, it's soil and weather conditions, extensive experience with mango production, progress made with the detection, control, and eradication of fruit flies, and the existence of Mediterranean fruit fly free zones declared and recognized by the USDA.

Potential areas for the establishment of fruit fly free zones in Guatemala include 5,000 hectares of mango production and export operations located in the province of Guayas, where the key areas would be the Parishes and Cantons of Chongón, Consuelo, Empalme, and Palestina.

Peru is projecting that it will officially declare approximately 30,000 ha of mango production area as fruit fly free zones by 2023 which, from October through January, would allow mango exports to the US without the need for the application of the hot water treatment.

If Peru maintains its successful fruit fly control and eradication campaign, the projection is that over the next five years it will have a minimum of 10,000 ha of mango production areas recognized by the USDA as fruit fly free zones in the departments of Piura, Lambayeque, and Ancash.

Lastly, Brazil has identified 25,000 ha of mango production areas in the States of Pernambuco and Bahía, with a priority on the Petrolina-Juazeiro corridor in Valle de San Francisco.

The National Mango Board (NMB) commissioned a research project in 2021 entitled "***Identification of mango production areas with potential to be declared fruit fly free zones or farms with low fruit fly prevalence in the five main mango producing countries that export to the US.***"

The countries of Mexico, Peru, Ecuador, Brazil, and Guatemala jointly export more than 90% of the total import volume of mangos coming into the US. These countries have soil and weather conditions that are suitable for mango production and, according to the respective ministries of agriculture of each one of these countries, collectively have 334,685 ha of mango production area, of which 96,014 ha (28.7%) export product to various destinations and 65,853 ha (19.7%) export product to the US.

Of the total number of hectares farmed for export purposes, 68.6% are allocated to production that is exported to the US. Of the total number of hectares farmed for export to the US, only the mangos sourced from 5,680 ha (8.6%) in Sinaloa, Mexico are shipped to the US without the need for the application of the quarantine hot water treatment, that is, from fruit fly free zones recognized by the US Department of Agriculture.

During the 2020 export season, the countries of Mexico, Guatemala, Ecuador, Peru, and Brazil exported 516,492 metric tons of fresh mangos to the US, of which 69,893 metric tons (13.5%) were mangos that were not subject to the mandatory quarantine hot water treatment.

The main varieties of mangos that are export to the US are Tommy Atkins, Kent, Ataulfo, Keitt, Haden, & Palmer

In order to be able to process and export mangos to the US, packinghouses previously needed to comply with the mandatory quarantine hot water treatment protocol, which is known as a systems approach mitigation measure (FAO, 2009, NIMF 14).

This is in response to the fact that in some of the mango production and export regions there is a presence of a pest: fruit flies.

This means that the fruit must be subjected to a quarantine hot water treatment to eliminate these pests before it is exported to the US and, although there are various alternative quarantine treatments such as: high temperature forced air treatment, high temperature forced air with controlled environment, and irradiation, the hot water treatment (immersing the fruit in hot water) is actually the least costly and most widely utilized measure by all of the countries that export mangos to the US.

Nevertheless, the main challenge for mango growers and exporters that ship product to the US consists in improving the overall quality of export mangos. Offering higher quality fruit in retail stores in the US will lead to an increase in sales and, with time, will increase the demand for mangos produced in the American continent.

Therefore, in order to satisfy consumers in the US and at the same time be in full compliance with USDA requirements from the standpoint of reducing the risk of fruit flies entering the US, this project proposes that all the mango production areas that export product to the US (65,853 ha) be declared fruit fly free zones.

This is the most sensible measure that the governments of Mexico, Guatemala, Ecuador, Peru, and Brazil, in partnership with the grower and exporter sectors that ship product to the US, should implement for the purposes of fostering the export of high-quality fruit, which in turn will lead to the creation of jobs and higher profits.

To that end, it will be necessary for the ministries of agriculture of each one of these five countries to strengthen the actions of their respective departments of plant health (National Phytosanitary Protection Organizations), in order to ensure that they have the necessary financial resources to develop a strategic plan for a National Fruit Fly Control and Eradication Program (MOSCAFRUT), in conjunction with the mango committees of the various agricultural export associations, so that in a period not to exceed 15 years the mango production and export areas that ship to the US can be declared fruit fly free zones by the NPPOs and be recognized by the USDA.

The proposal is that the Strategic Plan ***"INTERNATIONAL RECOGNITION OF FRUIT FLY FREE ZONES FOR MANGO (Mangifera indica) PRODUCTION AND EXPORT AREAS FROM THE AMERICAS TO THE US"*** be executed for the period 2022–2036 (15 years).

Through the successful execution of ALMA-MANGO, the objective of exporting a minimum of 250,000 metric tons of mangos to the US, without the application of the quarantine hot water treatment, from the approximately 30,000 ha (equivalent to 50% of the area currently producing mangos for export to the US) recognized by the USDA as fruit fly free zones, can be achieved.

The information collected during the research has allowed for the identification of 90,000 ha of geographical areas producing mangos in Mexico, Peru, Ecuador, Brazil, and Guatemala that have the greatest potential to be officially declared fruit fly free zones by the National Phytosanitary Protection Organizations (NPPO) of each one of the five governments and recognized by the US Department of Agriculture (USDA).

Having conducted an analysis of the information provided by the ministries of agriculture and the departments of plant health from the five countries under study, a determination was made that, of the current mango production areas that export to the US, only an area of 5,680 hectares located in Sinaloa, Mexico has been recognized internationally by the USDA as a fruit fly free zone.

2.1 General:

Identify the fruit fly free or low prevalence areas and/or farms in the mango (Mangifera indica) production areas for export to the US in Mexico, Guatemala, Peru, Ecuador, and Brazil.

2.2 Specifics:

2.2.1 Collect all the information available regarding fruit fly free or low prevalence areas in the five (5) main exporting countries to the US (Brazil, Ecuador, Guatemala, Mexico, and Peru).

2.2.2 Identify the fruit fly free or low prevalence areas in the mango production regions or those with potential for developing the crop in the aforementioned countries.

2.2.3 Classify the areas with the greatest potential to be established as fruit fly free zones based on their agroecological, biological, social, and economic characteristics.

2.2.4 Detail the necessary steps that must be followed to garner the support of national, international, and private organizations for the development and implementation of a program to establish fruit fly free zones that are recognized by the US.

2.2.5 Propose a detailed plan for the identification of free or low prevalence zones and/or farms in case the information does not exist in any of the countries considered in the program or project.

Export a minimum of 250,000 metric tons of mangos to the US without the application of the quarantine hot water treatment.

The main goal for mango growers and exporters in each one of the exporting countries is to get to the US market with excellent quality fruit for the consumer. The immersion of mangos in hot water for 60, 90, or 110 minutes to destroy any fruit fly eggs or larvae that are present in the flesh affects the external quality and shortens the shelf life of the mangos, which in turn causes economic losses for the overall mango industry.

The basic purpose consists in ensuring that the producing country can obtain the declaration as well as recognition by the importing country, in this case the US, for the mango crop fruit fly free zones which would represent an important step forward to benefit the industry as well as consumers.

For the US, the existence of these fruit fly control and eradication programs in Mexico, Guatemala, Ecuador, Peru, and Brazil, all of which include MOSCAMED, would reduce the possibility of infestations in States like Florida and California, and thus avoid eradication costs for these States.

The mango fruit fly (Anastrepha oblicua), is a part of the Tephritidae family of the fruit fly species (MOSCAFRUT), which includes the Mediterranean fruit fly (Ceratitis capitata), Citrus fly (Anastrepha ludens), Zapote fly (Anastrepha serpentina), and Guava fly (Anastrepha estriata), all of which are considered pests that are of economic and quarantine importance for fruit farming in general and, in the particular case of mango production, can cause economic damage between 30 and 40% of the overall production.

Areas with mango production and exports to the US have infestations of fruit flies that, in addition to the direct economic harm that they can cause to the production, also lead to quarantine barriers which, in order to be able to export mangos to the US, require the mandatory application of a quarantine hot water treatment (immersion of the fruit in hot water) in mango packinghouses, that seriously affects the quality of the exported mangos.

Both factors, direct economic damage to production and the economic cost of the quarantine hot water treatment for exports, represent an annual global economic loss of approximately $128.9 million for mango growers and exporters from Mexico, Guatemala, Ecuador, Peru, and Brazil.

This is estimated based on a baseline 15% of damage to production that equates to 1.5 metric tons/hectare, and an average US price of US $1/kg of fruit, for a total of 60,173 ha that currently produce and export mangos that are subjected to the hot water treatment protocol, as well as a cost of US $.35 per box of mangos for product subjected to the HWT protocol (exported to the US in 2020, 110,357,250 boxes (refer to table 2)).

TABLE 2:

ECONOMIC DAMAGE IMPACT DUE TO MOSCAFRUT/ AREAS THAT EXPORT TO THE US.
YEAR 2020

No.	Descripción	Hectáreas Afectadas	Cajas 4 kgs Exp. Anual	Perdidas Kgs/Ha	precio US $/kg	Costo US $/Caja	TOTAL (US $)
1	Daño Económico A la producción	60,173		1500	1		90259500
2	Costo Tratamiento Hidrotérmico		110,357,250			0.35	38625037.5
TOTAL		**60,173**	**110,357,250**				**128884538**

Source: Research Team

To access these specialized markets, improvements need to be made to the phytosanitary conditions of the fruit farming sector in the respective countries, and solutions need to be developed to overcome the phytosanitary barrier related to the production and trade of fruit products. Part of the solution is to carry out production practices under the umbrella of official control programs that meet the guidelines and requirements for the establishment of pest free production areas.

As a strategy to address this demand for regional trade exchange, the FAO introduced the concept of Pest Free Areas (PFA) to produce plants and/or vegetable products that are subject to minimal phytosanitary restrictions (FAO, 2006).

It is for this reason that, in order to execute a detection, control, and eradication program or project that seeks to officially establish and declare fruit fly free zones certified by the national phytosanitary protection organizations (NPPO), it is necessary to, first and foremost, have the respective standards issued by the National Phytosanitary Protection Office.

Additionally, support for the NPPO (National Phytosanitary Protection Organization) is key for it to be able to carry out the development and implementation of the official standards for the establishment of fruit fly free zones in accordance with international standards.

Full compliance with the measures established by the NPPO to create and maintain a fruit fly free zone requires the implementation of an operational project.

For this reason, the development and execution of a strategic plan in which, based on public-private partnerships, bilateral agreements or arrangements can be established that list the necessary specific activities that include the roles and responsibilities of the growers, exporters, and corresponding government agencies of the exporting countries, as well as the those of the US.

To that end, the NPPOs need to strengthen their current efforts in the phytosanitary health arena, especially in the various productive sectors that, like mangos, contribute to job creation and prosperity in rural communities, but require support with the integrated pest management of fruit flies.

For the 2022–2036 period, we have set the goal to eradicate, declare, and obtain international recognition for the 90,000 hectares as areas that are free of Mediterranean fruit fly, as well as other types of fruit flies, from which mango production will no longer be subject to quarantine restrictions in order for it to be exported to the US, or any other countries that have no presence or are free of fruit flies.

In basic terms, the research has consisted of the collection of information which has allowed for the identification and categorization of fruit fly free and low prevalence areas in farms that produce mangos or have the potential to do so.

The research was carried out in three phases:

5.1 First Phase:

The documentary research technique was used for secondary sources of information, including conducting consultations with secretariats and ministries of culture, namely, departments of fruit farming, geographic information agencies, plant health agencies, and mango committees for various mango growers and exporters associations.

Likewise, a search was conducted of the FAO STAT, Trade Map, OIRSA, and AIEA websites, as well as various thesis, journals, books, articles, and brochures associated with international mango trade and any fruit fly control programs implemented in the countries of Mexico, Peru, Ecuador, Brazil, and Guatemala.

5.2 Second Phase:

Once the collected information was recorded and stored, using the developed databases, an analysis was conducted to categorize existing fruit fly free or low prevalence areas in mango production regions. In the priority areas with the greatest potential to be declared as free zones, several strategies are proposed to incentivize support from national, international, and private organizations for the development and implementation of a program to establish fruit fly free zones and/or farms that would be recognized by agricultural authorities in the US.

5.3 Third Phase:

Lastly, based on the interpretation of the results obtained in mango production regions, a determination was made of the areas with the greatest potential for the establishment of fruit fly free zones for the purpose of exporting non-hot water treated mangos to the US.

The concept of a PFA (pest free area) is one element of the justification for the phytosanitary measures to protect an area at risk undertaken by an importer country, one that imposes requirements for the establishment of fruit fly free zones under the category of “pest free areas” that can range from an entire country to a small area that is free of pests but located within a country where the pest is prevalent.

In this case, it should correspond to the biology of the pest in question (FAO, 2006). In practice, pest free areas (PFA) are generally demarcated by easily recognizable borders that, by and large, adequately coincide with the biological limits of a pest.

They could be administrative in nature (for example, national, provincial, or communal borders), physical characteristics (rivers, oceans, mountain ranges, highways), or property limits that are clearly defined by all parties.

The International Standards for Phytosanitary Measures (ISPM) are created by the office of the International Plant Protection Convention (IPPC), the international phytosanitary technical organization for the World Trade Organization (WTO), as part of the global policy and technical assistance program on plant quarantines implemented by the UN Food and Agriculture Organization (FAO).

The establishment and use of a PFA (Pest Free Area) by a NPPO (National Phytosanitary Protection Organization) foresees the export of plants, vegetable products, and other regulated items from the country in which the area is located (exporting country), to another country (importing country) without the need for the application of additional phytosanitary measures, under the condition that certain requirements are met (IPPC, 2016)

In this manner, the pest free status conferred to an area can be used as the basis for the phytosanitary certification of plants, vegetable products, and other regulated items corresponding to the pests in question. According to the glossary of phytosanitary terms expressed in ISPM 5, the following general terms are used in the phytosanitary measures that are applicable to international trade.

6.1 Pest Free Areas:

An area in which a specific pest is absent, as demonstrated through scientific evidence and where, when appropriate, said status is officially maintained. In the case of fruit flies, FTD (Flies per Trap per Day) values equal to "0".

6.2 Low Pest Prevalence Areas:

An area identified by the competent authorities, ranging from an entire country, part of a country, or the totality or parts of several countries, in which a specific pest is present at low levels and is subject to effective monitoring or control measures.
In the specific case of fruit flies, it is considered a low prevalence area when the FTD (Flies per Trap per Day) levels are below 0.01.

6.3 Production Location:

Any facility or cluster of fields operated as a single production or agricultural unit.

6.4 Pest Free Production Location:

Production location in which a specific pest is absent, as demonstrated through scientific evidence, and where, when appropriate, this status is officially maintained for a definite time frame.

6.5 Pest Risk Management:

Assessment and selection of alternatives to reduce the risk of introduction and dispersion of a quarantine pest.

6.6 Phytosanitary Measure:

Any legislation, regulation, or official procedure that has the purpose of preventing the introduction or dispersion of quarantine pests or limiting the economic repercussions of regulated non-quarantine pests.

6.7 ISPM:

International standard for phytosanitary measures, adopted by the FAO conference, of the International Phytosanitary Protection Commission (IPPC).

6.8 National Phytosanitary Protection Organization (NPPO):

Official service established by a government to carry out the specific functions of the IPPC.

6.9 Quarantine Pest:

Pest of potential economic importance for the area at risk even when the pest is not present or, if present, is not broadly distributed and is under official control.

6.10 Pest Risk:

For quarantine pests, it's the probability of introduction and dispersion of a pest and magnitude of the potential economic consequences associated with it.

6.11 Production Site:

A defined segment of a production location that is managed as a separate unit for phytosanitary purposes.

6.12 Pest Free Production Site:

A production site in which a specific pest is absent, as demonstrated by scientific evidence, and where, when appropriate, this status is officially maintained for a definite timeframe. The establishment of pest free areas for fruit flies is regulated by ISPM 26, in which it breaks down the corresponding general and specific requirements.

The International Standards for Phytosanitary Measures (ISPM) are created by the office of the International Plant Protection Convention (IPPC), the international phytosanitary technical organization for the World Trade Organization (WTO), as part of the global policy and technical assistance program on plant quarantines implemented by the UN Food and Agriculture Organization (FAO).

This program offers these standards, guidelines, and recommendations to harmonize phytosanitary measures in the international arena to members of both the FAO as well as other interested parties for the purpose of facilitating trade and avoiding the use of unjustified measures such as trade barriers (FAO, 2009). The contracting parties (countries) of the IPPC adopt the ISPM through the Phytosanitary Measures Commission. The ISPM are standards, guidelines, and recommendations that are recognized as the foundation for the development of phytosanitary measures that members of the WTO can apply by virtue of the Agreement on The Application of Phytosanitary and Sanitary Measures (SPS Agreement) (FAO, 2009).

Guatemala is a signatory to the World Trade Organization (WTO) and, as such, must ensure the correct application of photo sanitary measures in international trade.

The Food and Agriculture Organization of the United Nations (FAO), has developed more than 37 international standards on phytosanitary management (ISPM) through the International Phytosanitary Protection Commission (IPPC) in support of the development of international trade, the most important of which are the following:

Requirements for the establishment of pest free areas **(ISPM 4, v.2017)**; Glossary of phytosanitary terms **(ISPM 5, v.2020)**; Determination of the status of a pest in an area **(ISPM 8, v.2017)**; Guidelines for pest eradication programs **(ISPM 9)**; Requirements for the establishment of pest free production locations and sites **(ISPM 10, v.2016)**; Application of integrated measures with a system approach to pest risk management **(ISPM 14, v.2019)**; Requirements for the establishment of low pest prevalence areas **(ISPM 22)**; Establishment of pest free areas for fruit flies (Tephritidae) **(ISPM 26, v.2020)**; Recognition of pest free and low pest prevalence areas **(ISPM 29)**; Establishment of low pest prevalence areas for fruit flies (Tephritidae) **(ISPM 30)**; Determination of the status of a fruit as a host for fruit flies **(ISPM 37).**
Additionally, reference is made to the Guidelines for the Establishment, Maintenance, and Verification of Fruit Fly Free Areas in North America – NAPPO **(ISPM 17, v.2019)**

7.1 FRUIT FLY SPECIES

7.1.1 United States of America

Although the United States of America has Mediterranean fruit fly free zone phytosanitary status, it has experienced recurrent incursions of the pest since 1924 which has obliged it to maintain a rigorous monitoring program to avoid having the pest settle in their territory.

According to APHIS, from 1975 to 2005 there were 24 outbreaks, whereas Carey (2010) reports that, between 1982 and 2010, sixty (60) successful eradication programs were implemented for C. capitata in the state of California to address the presence of the pest in 167 cities in that state. Beginning in 1996, a preventive release program was established using sterile flies in the States of California and Florida with a preventive wide-area approach to control further incursions by the pest that has proven to be more efficient than the reactive approach (detect – eradicate) to eradicate outbreaks that had been occurring up to that year.

Currently, the US government participates in the MOSCAMED Tri-national Cooperation Program with Mexico and Guatemala to contain and, eventually, eradicate the Mediterranean fruit fly from Guatemala, which in turn would reduce the risk of invasion and settlement of the pest in Mexico and in the US.

7.1.2 Guatemala

The Mediterranean fruit fly (Ceratitis capitata) is one of the pests in the fruit fly species that causes severe economic damage to fruit farming operations.

This pest is of economic and quarantine importance and is distributed throughout most of the world's fruit production areas affecting more than 200 species of fruit, while at the same time

causing production losses that vary between 20 and 40%, depending on the infestation levels and the type of fruit.

It was first reported in the American continent in 1911 in Brazil, from there it traveled northbound throughout the American continent settling in every country in South America and Central America. (See Figure 2).

FIGURE 2:

Displacement of the Mediterranean fruit fly in the American continent. Year 2021.

Source: *Research team, based on a literature review.*

It was detected for the first time on April 22 of 1975 in the villages of Trapiche, Asunción, Mita, & Jutiapa, and the presence of the Mediterranean fruit fly in Guatemalan territory was officially recognized by the MAGA. Immediately after, on May 19, 1975, the government report was issued declaring a national Mediterranean fly control emergency.

The presence of the Mediterranean fly in Guatemala placed the governments of Mexico and the US on high alert for phytosanitary issues, since the entry of this pest into their respective countries would cause millions of dollars in damage to the production sectors of both countries, given that both have a very strong and diverse fruit farming industry.

For this reason, an agreement was signed between the governments of Guatemala and the US on November 15, 1975, creating a bilateral agreement that formally established the MOSCAMED commission for the specific purpose of combating the damage caused by the Mediterranean fruit fly in Guatemalan territory. This agreement was approved by the Congress of the Republic of Guatemala on June 9, 1976, by way of Decree 21–76.

In 1977, the Mediterranean fly was detected in Mexican territory –in Tuxtla Chico, Chiapas—and the MOSCAMED program was established that same year to prevent the introduction of the pest into Mexico from the infested areas in Guatemala and the rest of Central America.

In 1982, only five years later, the Ministry of Agriculture and Livestock in Mexico declared the eradication of the Mediterranean fly in Chiapas, Mexico.

On February 21, 1977, a memorandum of understanding was signed between the Ministry of Agriculture of Guatemala and the US Department of Agriculture. On October 22, 1981, the cooperative agreement was signed between MAGA and USDA. Both agreements with USDA were ratified by the Congress of the Republic of Guatemala on July 9, 2002, by way of Decree number 43–2002.

At the national level, the MOSCAMED program derives its legal authority from the Plant and Animal Health Act, Decree No. 36–98, dated May 6, 1998, that States as its objective to protect the health of plant, animal, forest, and hydro biological species, as well as the preservation of their products and non-processed by-products, against any adverse impacts from pests and diseases of economic and quarantine importance, without any harm to human health and the environment.

To complement the functions developed by MOSCAMED in Guatemala, on December 15, 2011, the MOSCAMED program was created under the umbrella of the General Office of Plant Health of the Ministry of Agriculture, Livestock, and Food –MAGA--, which would support productivity and competitiveness in the fruit farming sector in Guatemalan territory through the prevention, detection, control, and eradication of agricultural pests of economic and quarantine importance, otherwise known as fruit flies.

In May 2014, a cooperation agreement was signed between the governments of the United States of America, the Republic of Guatemala, and the United Mexican States for the prevention, detection, suppression, and eradication of the Mediterranean fly, as well as other fruit flies of economic importance.

In Guatemala, actions have been undertaken for the last 46 years for the prevention, control, and eradication of the fruit fly known as the Mediterranean fruit fly (Ceratitis capitata wied). To date, a containment barrier has been successfully maintained, and has precluded the displacement of the pest along the continent towards Mexico and the US, nevertheless, the goal to eradicate and declare Guatemalan territory as a fruit fly free area has not been achieved.

7.1.3 Mexico

7.1.3.1 Mediterranean Fly

The presence of Mediterranean fly was officially reported by Mexico in 1977, having been detected for the first time in Tuxtla Chico, along the border with Guatemala.

In 1978, the MOSCAMED Program agency was created in Mexico, implementing the actions of detection, control, eradication of the Mediterranean fruit fly from Mexican territory.

In 1982 (four years after the beginning of the MOSCAMED program), the Ministry of Agriculture and Livestock of Mexico declared the eradication of the Mediterranean fruit fly in Chapa's, Mexico.

After that date, until now, the pest has been detected in the southeast and other Mexican States, sporadic outbreaks of Mediterranean flies, but they've been successfully controlled and eradicated, maintaining the status of Mediterranean fruit fly free areas.

Maintaining the Mexican territory free of Mediterranean fruit flies, to a large extent, is a result of the successful outcomes obtained in Guatemala, where they have satisfactorily maintained a containment barrier to avoid the movement of the pest along the continent toward Mexico.

7.1.3.2 The MOSCAFRUT Program

In Mexico, the National Fruit Fly Program is established by the Mediterranean Fruit Fly Program (MOSCAMED Program) headquartered in the city of Tapachula, Chiapas. The epidemiological monitoring of exotic fruit flies program and the National Campaign Against Fruit Flies of the Anastrepha genus (CNMF) are both headquartered in Mexico City.

The National Campaign Against Fruit Flies (CNMF) was established in Mexico in 1992 for the purpose of controlling and eradicating four species of fruit flies: Anastrepha ludens, Anastrepha oblicua, Anastrepha stricta, & Anastrepha serpentina.

For this reason, the Ministry of Agriculture and Water Resources (SARH) and the Inter American Institute for Cooperation in Agriculture (IICA) signed an agreement to engage in technical cooperation in the national campaign against fruit flies with the objective of managing the resources for the operations of this phytosanitary program.

Based on the provisions outlined in the Federal Plant Health Law, the first agreement through which the first fruit fly free zones were declared in Mexico was published in the Federal Register on July 26, 1995, for the municipalities of Comondú, Mulegé, and Loreto in Baja California Sur, 67 municipalities in the state of Sonora, and all the municipalities in the state of Chihuahua.

In 2001, the declarations for fruit fly free areas were published for the municipalities of Ahome, Choix, El Fuerte, Guasave, and Sinaloa de Leyva in the state of Sinaloa, and all the municipalities in the state of Coahuila.

In 2004, 32 municipalities in the state of Durango were declared fruit fly free. In 2005, the municipalities of Angostura, Badiraguato, Culiacán, Elota, Mocorito, Navolato, and Salvador Alvarado in the state of Sinaloa were declared fruit fly free. (Refer to Tables 6 & 7).

7.1.3.3 International Recognition for Fruit Fly Free Areas.

In 1998, the US Department of Agriculture (USDA) recognized the municipalities of Altar, Atil, Caborca, Carbó, Empalme, Guaymas, Hermosillo, Piquito, Plutarco Elías Calles, Puerto Peñasco, San Luis Río Colorado, and San Miguel Horcasitas in the state of Sonora as the first fruit fly free zone recognized at the international level.

In 1999, the USDA recognized the municipalities of Mulegé, Comondú, and Loreto from the state of Baja California Sur, six municipalities from the state of Sonora, and the municipalities of Bachiniva, Casas Grandes, Cuauhtémoc, Guerrero, Namiquipa, and Nuevo Casas Grandes in the state of Chihuahua.

On June 25, 2003, the USDA recognized the municipalities of La Paz and Los Cabos, in the state of Baja California Sur, and the municipalities of Ahome, Choix, El Fuerte, Guasave, and Sinaloa de Leyva, in the state of Sinaloa.

7.1.4 Ecuador

According to J. Aldrich, the presence of fruit flies in Ecuador has been reported since 1925.

Since 1959, Ecuador has conducted studies for the purpose of understanding fruit fly species and ways to undertake measures to manage and control them. In 1976, Mediterranean fruit flies (Ceratitis capitata) entered through the southern border, affecting the phytosanitary problems in the Ecuadorian fruit farming sector.

In the beginning, the problems caused by fruit flies caught the attention of fruit farmers in the inter-Andean region but, currently, the 10,000 ha of mango farms set aside for the export market in Guayas and Los Ríos have required the interest of producers due to the rigorous measures imposed by countries that buy the fruit.

The first campaign against fruit flies in Ecuador was carried out in the Cantons of Paute and Gualaceo, in November of 1965 (NEIRA, 1982), and was led by Ing. Lucio Vivar and Alfonso Altamirano, as well as agronomical engineers Guillermo León and Jorge Vidal.

During the 1980s, it was well known that Ecuador had the presence of 11 species of the Anastrepha genus.

In 1992, a determination was made in Ecuador that the most important species of fruit flies are: Anastrepha fraterculus Wiedemann and Ceratitis capitata (Wied.), (Molineros, Tigrero and Sandoval, 1992). However, by 1992 there were at least 28 species of the Anastrepha genus reported to be present.

In 1998, a review was carried out of the fruit fly species that were present in Ecuador, and there were reports of 31 species of the of the Anastrepha genus, Toxotrypana recurcauda, and Ceratitis capitata.

The new species of Anastrepha amaryllis was described.

The reported species are: A. nambacoli (=A. macrura), A. grandis, A. atrox, A. concava, A. monteu, A. amaryllis, A. ornata, A. serpentina, A. striata, A. sp. posible integra, A. townsendi, A. nigripalpis, A. buski, A. mucro- nota, A. debilis, A. sp. cercana a debilis, A. crebra, A. obliqua, A. sororcula, A. fraterculus, A. bahiensis, A. distincta, A. sp. cercana a distincta, A. pseu- doparallela, A. sp. cercana a barnesi, A. leptozona, A. dryas, A. chiclayae, A. manihoti, A. rheediae, and A. tecta (Tigrero, 1998).

In the technical report entitled “Generation of technological alternatives for fruit fly control along the Ecuadorian coastline” they report the presence in Guayas of A. dissimilis, A. pickeli, and A. antunesi (Arias, 2003).

In 2005, a description was made of Anastrepha punensis (Tigrero and Salas, 2005). In 2006, a determination and description of A. sachay A. vermespinata (Tigrero and Salas, 2006). In 2007, a description was made of A. trimaculatay A. tumbalai (Tigrero and Salas, 2007). A. tsachila, A. rollinianay A. mikuymono (Tigrero, 2007) In 2009, a description was made of A. asetaocelata (Tigrero and Salas, 2009).

Currently, Ecuador reports a total of 37 species of Anastrepha.

The fruit flies of the Anastrepha Schiner genus are native to the American continent.

As observed, Ecuador is a center for various species of flies belonging to this genus (Korytkowski, 1992), the Amazon region being the principal one, but according to the most recent results obtained regarding new species that have been described (Tigrero 2006, 2007, and 2009), the coastline has also recorded four (4) new species for science, most of them found in the Guayas province. This is due to the fact that it is the only area that maintains constant monitoring as a result of the mango production for export operations located there.

If, indeed, there was a determination that the most important species of the Anastrepha genus is A. fraterculus, given that it attacks hosts of economic importance as well as its wide distribution, the Mediterranean fly is currently distributed in practically all the fruit farming/production zones of economic importance, which has obliged the countries that buy fruit products to demand quarantine measures for the purchase of fruits (AGROCALIDAD, 2010).

In 2008, the presence of Ceratitis capitata was identified for the first time in Isla San Cristóbal, it was observed later on in Santa Cruz, Isabela, and Floreana, which led to the initiation of eradication measures for this species in the Galapagos islands for the purpose of avoiding the dissemination and the establishment of this pest.

In 2008, by Executive Decree No. 1449, dated December 2, the Ecuadorian Agricultural Health Service was reorganized and became the Ecuadorian Agency for Agricultural Quality Assurance, currently known as AGROCALIDAD, a public technical agency with legal authority and standing, self-funded and capitalized, decentralized, with administrative, economic, financial and operational independence, and with jurisdiction over the entire Ecuadorian territory.

AGROCALIDAD took on the role of National Phytosanitary Protection Organization as the responsible agency in charge of developing the different official standards related to phytosanitary management that are demanded by international trade.

The Agency for Regulation and Control for Bio Security and Quarantine for Galapagos (ABG), along with AGROCALIDAD in Ecuador, establish the appropriate mechanisms to ensure the marketing of agricultural products that are free of any pests.

For this reason, AGROCALIDAD and ABG decided to implement a National Fruit Fly Project for the purposes of monitoring, controlling, and/or eradicating this species and, in this way, offer products that are free of fruit flies to be able to access new international markets as well as avoid the economic losses caused by these pests.

On December 31, 2013, the National Planning and Development Secretariat of Ecuador, by way of File No. SGPBV-2013-1419-07, approved the national fruit fly management project in Ecuador.

In 2014, the approval was issued for the execution of the “National Fruit Fly Management Project in Ecuador (PNMMF)”, in the provinces of Pichincha, Chimborazo, Imbabura, Cotopaxi, Tungurahua, Santa Elena, Guayas, Manabí, Los Ríos, Santo Domingo de los Tsáchilas, Morona Santiago, Napo, Bolívar, Azuay and Carchi.

This project contemplates the execution of the following components: Diagnostic and Monitoring, Quarantine, Pest Management in the Field, Analytical Capacity, Awareness, and Dissemination.

The main results that were obtained indicated that, by 2013, through resolution DAJ-2013465-0201.0224 issued on November 25, a declaration was made that the canton of Mejía, a low fruit fly prevalence area (Ceratitis capitata) where there are production sites for Peruvian groundcherries (Physalis peruviana) that are free from the aforementioned pest, was a risk management alternative for the compliance of phytosanitary requirements for export.

In the Galapagos islands, the levels of fruit fly infestation are considered of low prevalence, given that it’s FTD (Flies/Trap/Day) values are below 0.01.

In Santa Cruz the index is 0.006, San Cristóbal is 0.003, Isabela 0.001 and Floreana 0.0, which means that the populations of fruit flies are under control and in small numbers.

7.1.5 Peru

Fruit flies (Ceratitis Capitata and Anastrepha spp) are one of the most harmful pests that attack fruits and other crops in Peru.

According to the National Agricultural Health Service (SENASA), the estimated losses caused by fruit fly infestation in Peru constitute at least 30% of the total production of the host crops, and approximately 233,000 fruit farmers in the Peruvian coastal regions are directly affected by the pest.

These fruit farmers have had to implement pest control measures that increase their production costs. In some cases, their access to international markets has been limited by the phytosanitary restrictions imposed on the infested areas.

There is a hypothesis that fruit fly infestation in Peru came from Brazil, asserting that the Mediterranean fly was detected for the first time in Peru in 1956 in a citrus shipment in the region of Huánuco.

Subsequently, its presence was recorded on the coast: Santa Eulalia and in la Molina (Rodríguez, 1998). It was detected in the Ica region two years later, in 1958.

In Peru, the two main genus of fruit fly that cause damage are: Anastrepha and Ceratitis (Rodriguez, et al., 1997), including the following species:

- Ceratitis capitata Wiedemann Mediterranean fruit fly
- Anastrepha fraterculus Wiedemann South American fruit fly.
- Anastrepha striata Schiner Guava fruit fly.
- Anastrepha distincta Greene Pacae fruit fly.
- Anastrepha serpentina Wiedemann Sapodilla fruit fly.
- Anastrepha oblicua Macquart Plum fruit fly.

Figure 3 shows the geographical distribution of the main fruit flies that are present in Peru.

FIGURE 3:

DISTRIBUTION OF THE MAIN FRUIT FLIES IN PERU.

Source: Researcher, based on a literature review.

Since the fruit fly species is a very severe pest of great economic importance for the fruit production sector, SENASA and MINAGRI deemed it necessary to implement an institutional program for the prevention, detection, control, and eradication of this pest for the purpose of protecting and stimulating the Peruvian agricultural exports sector.

In this regard, since the 1980s, they undertook the development of a fruit fly control and eradication program in the Peruvian territory with the support of the Inter-American Institute for Cooperation on Agriculture (IICA).

Nevertheless, it wasn't until 1998 that they executed a more concrete long-term strategy for the eradication of fruit flies in the entire Republic of Peru, with the support of the International Development Bank (BIB).

In 1998, the Agricultural Health Development Program (PRODESA) was the first project implemented for this purpose (through a sovereign guarantee loan of US$45 million), followed by the Fruit Fly Control and Eradication Project (through a sovereign guarantee loan of US$15 million).

Subsequently, in 2009, the bank approved a third sovereign guarantee loan for US$25 million.

This long-term strategy for fruit fly control and eradication in Peru led to the creation of the Sub-directorate of Fruit Fly Control, attached to the National Agricultural Health Secretariat (SENASA) of the Ministry of Agriculture and Irrigation (MINAGRI), that proposed the eradication of the pest in five stages:

Stage I: 1998-2005
Stage II: 2006-2009
Stage III: 2010-2013
Stage IV: 2014-2019
Stage V: 2020-2024

For this purpose, the Sub-directorate of Fruit Fly Control and Phytosanitary Projects set a general objective to "Resolve in a consistent and durable manner the problem posed by fruit flies in Peru," maintaining two basic lines of action:

a) Maintain the national monitoring system
b) Implement control, suppression, and eradication projects

The strategy implemented by SENASA, through the Sub-directorate of Fruit Fly Control, for regulating the pest encompassed five stages of intervention and an approximate timeframe of four years until the objective of obtaining the fruit fly free declaration was met (Refer to Figure 4).

The five stages are:
1) Surveying and monitoring (surveillance).
2) Suppression (collection and burial of fruits that were host to the pest).
3) Eradication (application of toxic bait).
4) Post-eradication (the rate of incidences declines because it is reaching eradication conditions).
5) Prevention.

FIGURE 4:
FRUIT FLY ERADICATION PROCESS STAGES.

Source: *Fruit Fly Sub-directorate*, SENASA, MINAGRI.

6.4.2 Results:

6.4.2.1 MOSCA I Project: 1998-2005

The MOSCA I project, had the objective of eradicating a species of fruit fly (Ceratitis capitata) from the departments of Tacna and Moquegua. In Project I, the eradication strategy was not set up in stages. An investment of US$74,154,863 was made in the project (Tacna, Moquegua, pilot areas, institutional strengthening).

6.4.2.2 MOSCA II Project: 2006-2009

This project also had the objective of eradicating a single species of fruit fly (Ceratitis capitata), however, other species of the Anastrepha genus were also eradicated during the execution process.

In this project, the strategy was broken down by stages with pre-defined activities and periods. For the year 2008 in Arequipa, and 2009 in ICA, the departments were declared fully eradicated from Mediterranean fruit fly, Pacae fruit fly, South American fruit fly, and Sapotaceae (Sapote) fruit fly.

Stage II was carried out with an investment of US$46,660,354 (Arequipa, Ica, Lambayeque)

6.4.2.3 MOSCA III Project: 2010-2013

This project was the continuation of the south-north eradication strategy.

The fundamental objective was to recognize Valle de Cañete (Lima) as a fruit fly free area and, likewise, the rest of the Lima provinces during the post-eradication period, including the departments of Ancash, Virú, Pataz, and La Libertad, as well as the inter-andean valleys of Junín, Huánuco and Pasco.

These actions were a part of the Agricultural Health and Produce Safety Development – PRODESA, which was executed by SENASA for the purpose of eradicating fruit flies in the departments of Piura, Tumbes, Lambayeque, La Libertad, Amazonas, Apurímac, Cusco, Puno, and Cajamarca.

Stage III was carried out from 2010 to 2014, at an investment of US$113,558,762 (Lima, Áncash, La Libertad, Ayacucho, Huancavelica, Junín, Huánuco and Pasco).

6.4.2.4 MOSCA IV Project: 2014-2019

The National Agricultural Health Service (SENASA) developed Stage IV of the fruit fly eradication project for the 2019-2023 period.

The objective is to declare 103,000 ha located in the regions of Tumbes, Piura, Lambayeque, La Libertad, Cajamarca, Amazonas, Apurímac, Cusco, and Puno as fruit fly free areas.

These actions (which include the operational and quarantine components) involved an investment of $115 million (with support from the IDB through a loan and matching funds contributed by the state) and will benefit 880,000 fruit producers.

Table 5 shows that during the period from 1998–2021 (24 years), Peru has invested a total of US$349.4 million, at an average annual amount of US$14.6 million.

7.1.6 Brazil

The Mediterranean fruit fly (Ceratitis capitata) was detected for the first time in Brazil in 1901, and subsequently spread throughout the entire country and the rest of the American continent. Another fruit fly that is present in Brazil is the Carambola (Bactrocera carambolae) fruit fly, which is a quarantine pest that was detected in Brazil in 1995, in the States of Amapá, Pará and Roraima, which are located far from the Brazilian fruit production centers.

The main species of Anastrepha that exist in Brazilian fruit production centers are: Anastrepha obliqua, Anastrepha fraterculus and Anastrepha grandis.

In 2015, the Ministry of Agriculture, Livestock, and Supply (MAPA) established the National Fruit Fly Program (PNMF), attaching greater emphasis to the Mediterranean fruit fly, as well as the fruit flies of the Anastrepha genus, including the following species: fraterculus, oblicua, grandis, and the Carambola fruit fly: Bactrocera carambolae, a species restricted to the States of Amapá, Pará and Roraima.

FIGURE 5:

NATIONAL FRUIT FLY PROGRAM LAUNCH.

Source: National Fruit Fly Program*, Brazil, 2015*

Source: National Fruit Fly Program*, Brazil, 2015*

The National Fruit Fly Program – PNMF – is created as part of the Ministry of Agriculture, Livestock, and Supply (MAPA).

The MAPA established goals that included suppressing the Mediterranean fruit fly population, recognizing the region located above the 13th parallel as an Anastrepha grandis fruit fly free area, and controlling fruit flies in the Valle de San Francisco.

Nevertheless, the PNMF specifically established the objective of developing phytosanitary policies for the prevention, control, and eradication of fruit flies of economic and quarantine importance for Brazil and for the Brazilian fruits import market. To that end, MAPA, Plant Health, and PNMF are planning for the possibility of eradicating fruit flies of economic and quarantine importance, and eventually establish areas that are free of these pests.

The PNMF, is made up of four sub-programs:

1. Bactrocera carambolae;
2. Anastrepha spp;
3. Ceratitis capitata;
4. Other fruit flies of economic in quarantine importance.

The Anastrepha spp sub program will include the species: Anastrepha grandis, A. fraterculus, and A. obliqua.

PNMF actions will be implemented on a priority basis in the municipalities that have already received official recognition as Pest Free Areas, Low Prevalence Areas, or Integrated Measures Areas as part of the Risk Management System strategy.

Coverage will also be provided for municipalities where the implementation of prevention, control, and eradication actions for quarantine pests is deemed unnecessary at the discretion of the Secretariat of Agricultural Defense.

According to information from MAPA, Brazil will invest $34 million in the effort against one of the most relevant pests in Brazilian fruit farming, fruit flies, that cause economic damage on the order of US$120 million a year between production losses and control, processing, and marketing costs.

The objective of the program is to establish international controls on pest monitoring policies in Guyana, French Guyana, Suriname, Venezuela, and Trinidad and Tobago, in addition to the inclusion of permanent surveillance systems in ports of entry and airports located in unaffected regions for the purposes of preventing dispersion.

As indicated, in some regions of Brazil it is also possible to find the Carambola fruit fly (Bactrocera carambolae) during the eradication process that, in addition to affecting this fruit, also affects 50 other fruits.

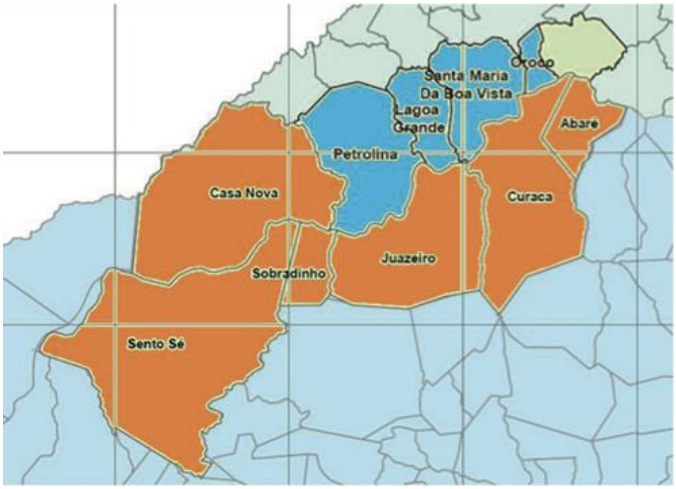
The investment program will cover the implementation of risk mitigation systems, as well as certification and eradication programs.

Additionally, US$1.5 million will be directed to the sub program each year to eliminate the Carambola fruit fly.

In 2011, the municipalities of Belén de San Francisco, Petrolina and Santa María de Buena Vista, from the state of Pernambuco, implemented the risk management system for pests in an effort to control the fruit fly in mango farming operations (refer to Figure 6)

FIGURE 6:

RISK MANAGEMENT SYSTEMS FOR MANGO FRUIT FLIES



Source: *National Fruit Fly Program, Brazil*, 2015

Brazil has the appropriate organization for the detection, control, eradication, and establishment of fruit fly free areas and who, can highlight the following achievements:

a) Eradication of Bactrocera carambolae in the States Amapá, Pará and Roraima.

b) Suppression of Ceratitis capitata in Valle de San Francisco in the States of Pernambuco and Bahía.

c) Risk management system in the production and export of papaya for the Ceratitis capitata and Anastrepha fraterculus pests in the States of Espíritu Santo and Río Grande Do Norte.

d) Risk management system in the production and export of cucurbitaceous for the Anastrepha grandis pest in the States of Bahía, Golás, Minas Gerais, Sao Pablo, Paraná and Río Grande Du Sul.

e) Risk management system in the production and export of mango for the Ceratitis capitata and Anastrepha spp. in the state of Pernambuco and Bahía.

f) In the States of Bahía and Río grande do Sul facilities have been built for the production of sterile male fruit flies to support the autocidal control strategy.

Figure 7 shows the various advances made with regard to fruit flies in Brazil.

FIGURE 7:

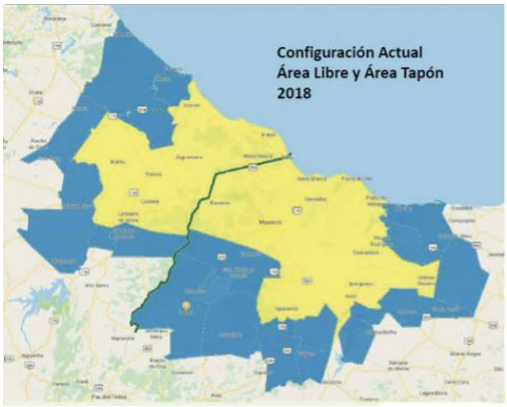
ADVANCES MADE IN BRAZIL IN FRUIT FLY CONTROL AND ERADICATION

Source: *Obtained from* Regina Sugayama (Status of fruit flies in Brazil, 2016).

g) The States of Ceará (7 municipalities) and Rio Grande do Norte (13 municipalities) now have 20 municipalities that have been recognized as fruit fly free areas (Anastrepha grandis), after verification by the Ministry of Agriculture, Livestock, and Supply (MAPA) of the expansion of the Pest Free Area (ALP). Refer to Figure No. 8.

FIGURE 8:

AREA FREE OF ANASTREPHA GRANDIS IN THE STATES OF CEARÁ AND RÍO GRANDE DO NORTE



Source: *National Fruit Fly Program*, Brazil.

7.2 MANGO PRODUCTION AND EXPORT

7.2.1 Mango Production Areas

According to data provided by the official offices of the secretariats and ministries of agriculture, in the countries of Mexico, Guatemala, Ecuador, Peru, and Brazil there are 334,685 ha (Refer to Table 3).

62% of the mangos farmed in the region is found in Mexico along the Pacific coastline, and in the States of Sinaloa, Nayarit, Michoacan, Guerrero, Oaxaca, and Chiapas.

An area of 96,014 ha is dedicated to the export of mangos to different destinations, and, of these, 65,853 ha are areas that produce mangos for export specifically to the US, which is equivalent to 20% of all mango production, and represents 69% of the total area dedicated to the export market.

TABLE 3:

EXPORT TO THE US FROM FRUIT FLY FREE AREAS CERTIFIED BY MOSCAFRUT AND RECOGNIZED BY THE USDA IN MANGO PRODUCTION ZONES. YEAR 2020

No.	COUNTRY	TOTAL AREA PLANTED (HAS)	EXPORT AREA (HAS)	EXPORT AREAS to US (HAS)	FREE AREAS EXPORT to US (HAS)	PERCENTAGE EXPORTED to US (FREE AREAS)
1	Mexico	208,000	47,185	46,945	5,680	12.099
2	Peru	34,581	27,568	8,810	0	0
3	Ecuador	8,000	5,724	5,377	0	0
4	Brazil	74,529	12,537	2,421	0	0
5	Guatemala	9,575	3,000	2,300	0	0
TOTAL		**334,685**	**96,014**	**65,853**	**5,680**	**8.625271438**

Source: Research team.

According to information provided by the Secretariats and Ministries of Agriculture, the National Phytosanitary Protection Organizations (NPPO), the National Fruit Fly Control and Eradication Programs (MOSCAFRUT), the mango exporter associations, and the departments of fruit farming, which include promoting mango production, there are currently 65,853 ha of mango production that export specifically to the US.

Currently, of the total number of hectares dedicated to the export of mangos to the US, only 5,680 ha (8.63%) have been recognized by the USDA as fruit fly free areas.

From these free areas, located in municipalities in the northern part of the state of Sinaloa, Mexico, 69,893 metric tons of mangos are exported to the US without the need for the application of the postharvest hot water treatment.

This export volume, not subject to the mandatory quarantine hot water treatment, corresponds to 13.5% of the total of 516,492 metric tons of mangos exported to the US (Refer to Table 3 A).

TABLE 3A:

EXPORTS TO THE US FROM FRUIT FLY FREE AREAS CERTIFIED BY MOSCAFRUT AND RECOGNIZED INTERNATIONALLY BY THE USDA/US. YEAR 2020

No.	COUNTRY	EXPORTS to US - MT	EXPORTS FROM FREE AREAS - MT	PERCENTAGE OF FREE AREAS (%)
1	Mexico	332,921	69,893	20.99386942
2	Peru	74,882	0	0
3	Brazil	46,957	0	0
4	Ecuador	46,110	0	0
5	Guatemala	15,622	0	0
TOTAL		**516,492**	**69,893**	**13.53225219**

Table 3B provides greater detail about the behavior of national exports shipped from the countries of Mexico, Guatemala, Ecuador, Peru, and Brazil.

In total, during the 2020 season, 129.8 million 4kg boxes were exported to the US. Mexico exports 64% of the total export volume from the five main exporting countries to the US.

TABLE 3B:

WEEK No.	MEXICO 2020	PERU	ECUADOR 2021	BRAZIL	GUATEMALA 2021	TOTAL
1	29734	2,201,213	103,382	0	0	2334329
2	143502	2,486,555	40,449	0	0	2670506
3	305963	3,668,688	0	0	0	3974651
4	559336	3,057,240	0	0	0	3616576
5	724363	0	0	0	0	724363
6	685695	0	0	0	0	685695
7	829283	0	0	0	0	829283
8	713428	0	0	0	5,600	719028
9	1046730	0	0	0	44,643	1091373
10	1356592	0	0	0	64,993	1421585
11	1570133	0	0	0	165,957	1736090
12	1775449	0	0	0	322,714	2098163
13	2052015	0	0	0	392,547	2444562
14	1847177	0	0	0	494,606	2341783
15	2825365	0	0	0	713,888	3539253
16	2882540	0	0	0	740,536	3623076
17	2885060	0	0	0	514,593	3399653
18	2203872	0	0	0	302,109	2505981
19	2429475	0	0	0	143,191	2572666
20	2428610	0	0	0	0	2428610
21	2507985	0	0	0	0	2507985
22	3059000	0	0	0	0	3059000
23	3603422	0	0	0	0	3603422
24	4147845	0	0	0	0	4147845
25	4133816	0	0	0	0	4133816
26	3804222	0	0	0	0	3804222
27	3339255	0	0	0	0	3339255
28	3190253	0	0	0	0	3190253
29	3540965	0	0	0	0	3540965
30	3496888	0	0	0	0	3496888
31	3415708	0	0	0	0	3415708
32	3249068	0	0	73,808	0	3322876
33	2905305	0	0	254,546	0	3159851
34	2556996	0	0	501,214	0	3058210
35	2162347	0	0	626,655	0	2789002
36	1818021	0	0	771,109	0	2589130
37	1408100	0	0	879,774	0	2287874
38	955204	0	71,216	1,070,445	0	2096865
39	473942	0	152,056	1,080,124	0	1706122

40	167409	0	312,178	1,091,698	0	1571285
41	0	0	424,411	22,456	0	446867
42	0	0	944,596	2,001,674	0	2946270
43	0	0	1,274,623	875,216	0	2149839
44	0	0	1,536,142	738,363	0	2274505
45	0	0	1,234,033	341,663	0	1575696
46	0	50954	1,552,882	403,171	0	2007007
47	0	81526	1,380,701	342,125	0	1804352
48	0	407632	1,184,447	302,944	0	1895023
49	0	886599	780,962	115,752	0	1783313
50	0	1477666	725,991	151,267	0	2354924
51	0	1885298	342,368	95,256	0	2322922
52	0	2517128	189,791	0	0	2706919
TOTAL	**83230073**	**18,720,499**	**12250228**	**11,739,260**	**3905377**	**129845437**
%	**64.099344**	**14**	9.4344694	**9**	**3.0077122**	**100**

Source: Research team, based on data obtained from USDA/APHIS.

9.1 MEXICO

9.1.1 MANGO PRODUCTION AREAS IN MEXICO

According to data provided by SAGARPA, SIAP, and *Empacadoras de Mango de Exportación* (EMEX), Mexico has an average of 208,456 ha of mango production areas that produce 1,954,203 metric tons, with the production currently distributed throughout 23 States in the country.

97% of the production is found in the States of Sinaloa, Nayarit, Michoacán, Guerrero, Oaxaca, Chiapas, Veracruz, Jalisco and Colima (Refer to Table 4.)

TABLE 4:

GEOGRAPHIC DISTRIBUTION OF PRODUCTION AREAS FOR MANGO (MANGUIFERA INDICA), REPUBLIC OF MEXICO. YEAR 2020

No.	STATE	HECTARES	Percentage	% ACCUMULATED
1	Chiapas	38705	18.5	
2	Sinaloa	33892	16.2	
3	Nayarit	27566	13.2	
4	Guerrero	26940	12.9	
5	Michoacan	25437	12.2	
6	Oaxaca	19196	9.2	
7	Veracruz	18424	8.8	
8	Jalisco	7880	3.7	
9	Colima	4266	2	97.0497371
10	Campeche	1725	0.8	
11	Baja California Sur	1681	0.8	

12	Tamaulipas	858	0.4	
13	Durango	400	0.2	
14	State of Mexico	370	0.1	
15	Morelos	337	0.2	
16	Tabasco	194	0.1	
17	Yucatan	152	0.1	
18	Sonora	136	0.6	
19	Hidalgo	83	0	
20	Queretaro	77	0	
21	San Luis Potosi	55	0	
22	Puebla	54	0	
23	Zacatecas	28	0	
TOTAL		**207871**	**100**	

Source: Research team, based on data obtained from the SIAP.

9.1.2 LOCATION OF THE MANGO PRODUCTION AREAS THAT EXPORT TO THE US

According to information provided by the National Mango Product System Committee (CONASPROMANGO), in 2019, Mexico had approximately 50,000 producers who, according to information provided by SIAP, collectively represented 208,456 ha of mango production area, of which 193,458 ha were harvested with an average annual production of 1,954,203 metric tons.

Currently, the mango export program to the US is operated under an agreement between USDA/APHIS and SENASICA, with an average annual export volume of 332,921 metric tons, broken down as follows:

a) 69,893 metric tons without hot water treatment from the fruit fly free areas of five municipalities located in the northern part of the state of Sinaloa (Source USDA/APHIS)

b) 5,170 metric tons with irradiation treatment from the States of Chiapas, Oaxaca, Michoacán and Colima (Source USDA/APHIS).

c) 257,858 metric tons with hot water treatment from the States of Sinaloa, Nayarit, Michoacán, Guerrero, Oaxaca and Chiapas (Source USDA/APHIS).

Mexico exports an annual average of 50,000 metric tons to other destinations. Therefore, of the total amount exported by Mexico, 88% is shipped to the US market.

9.1.3 MANGO EXPORT VOLUMES IN MEXICO

9.1.3.1 MANGOS WITHOUT HOT WATER TREATMENT

On June 25 of 2003, the USDA recognized the municipalities of La Paz, and Los Cabos in Baja California Sur, as well as the municipalities of Ahome, Choix, El Fuerte, Guasave, and Sinaloa de Leyva, in the state of Sinaloa as fruit fly free areas, including Ceratitis capitata, Anastrepha oblicua, Anastrepha ludens, Anastrepha striata and Anastrepha serpentina.

Starting on July 13, 2003, Mexico began exporting mangos to the US that did not receive the postharvest quarantine treatment (hot water) from the municipalities of Ahome, Choix, El Fuerte, Guasave and Sinaloa de Leyva, located in northern Sinaloa.

In July 2015, the Association of Mango Producers and Exporters from The Fruit Fly Free Zone was established for the purposes of advocating for the interests of the free zone and serve as a liaison to different official agencies and organizations.

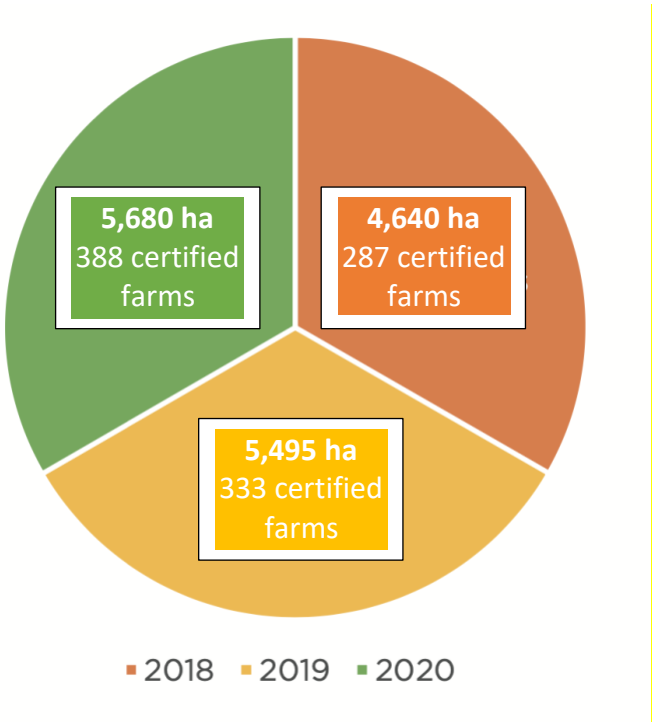
On average, during the export seasons from 2018–2020, there were 5,272 ha certified for mango exports to the US without hot water treatment from which 15.2 million 4kg boxes were shipped, which equates to 61,000 metric tons (Refer to Table 5).

TABLE 5:

EXPORT VOLUMES TO THE US WITHOUT HOT WATER TREATMENT. YEAR 2020

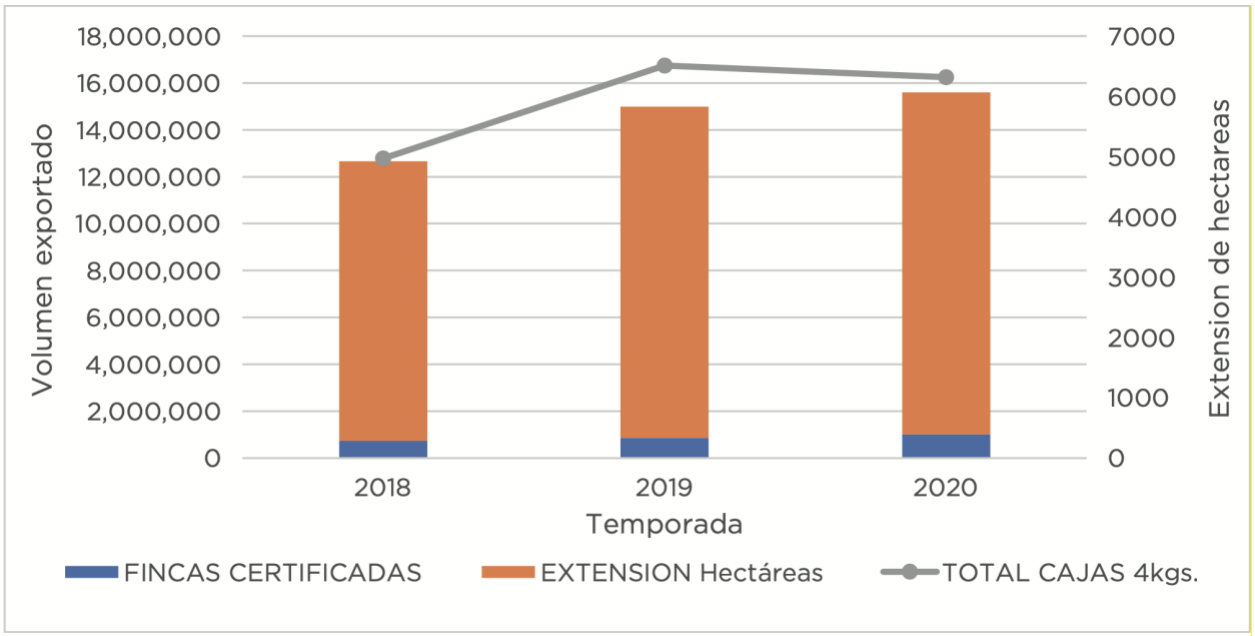
No.	SEASON	CERTIFIED FARMS	EXTENSION Hectares	TOTAL 4kgs. BOXES
1	2018	287	4640	12,782,619
2	2019	333	5495	16,741,011
3	2020	388	5680	16,242,192
TOTAL		**1008**	**15815**	**45,765,822**
AVERAGE		**336**	**5271.666667**	**15255274**

FIGURE 9: CERTIFIED FARMS PER YEAR



Source: Research team.

FIGURE 10: ***COMPARATIVE GRAPH OF EXPORTS***



Using the 2020 export season as a reference, the Association of mango exporters from the fruit fly free zone reported that during that year 16,242,192 4kg boxes of mangos were exported without the hot water treatment, the equivalent of 64,969 metric tons.

For that same season, the USDA/APHIS reported 17,473,203 4 kg boxes, the equivalent of 69,893 metric tons.

In total, there are 19 packinghouses in the fruit fly free zone: Agrícola Cuadras, El Potrero, Agrícola Daniella, Agrícola Duque, El Bitachi, Exportalizas, La Primavera, Agrícola Jahuara, Roberto Mango II, Lomalida, Ranchito Max, Agrícola Villa Ahome, Agrícola Martín del Campo, Mendoza, Agrícola Nio, Agropalenque, Siproin, Serrano and Apyc.

During the 2018-2020 seasons, the mango varieties that were exported to the US from these fruit fly free zones, in descending order, are: Keitt (46.6 %), Kent (39.2 %), Ataulfo (12.7 %), Tommy Atkins (1.42 %) and Haden (0.14 %). (Refer to Table 6)

TABLE 6:

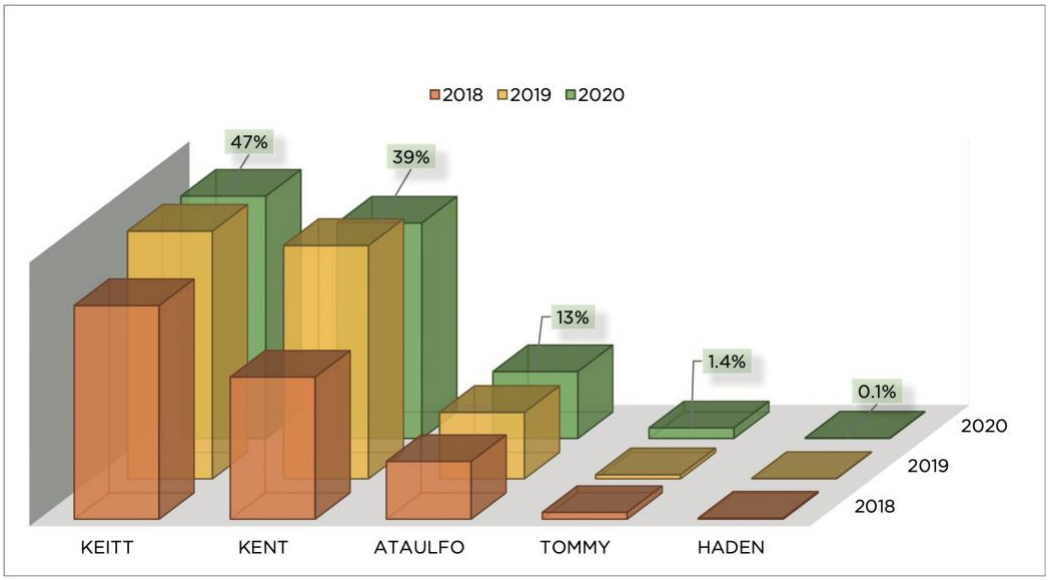
ORIGINATING FROM THE FRUIT FLY FREE AREAS. SINALOA, MEXICO (BOXES - 4KG) YEAR 2018-2020

No.	MANGO VARIETIES	2018	2019	2020	TOTAL	AVERAGE	%
1	KEITT	6,480,470	7,513,262	7,348,570	21,342,302	7114100.7	47 39 13 1.4 0.1
2	KENT	4,309,593	7,076,406	6,534,038	17920037	5973345.7	
3	ATAULFO	1,751,215	2,015,927	2,025,387	5792529	1930843	
4	TOMMY	206,397	123,234	318,867	648498	216166	
5	HADEN	34,944	12,182	15,330	62456	20818.667	
	TOTAL	**12782619**	**16741011**	**16242192**	**45765822**	**15255274**	**100**

Source: *Research team.*

FIGURE 11:

MAIN MANGO VARIETIES EXPORTED TO THE US



Source: *Research team.*

9.1.3.2 MANGOS WITH HOT WATER TREATMENT

According to data provided by SAGARPA and EMEX, mangos harvested for export to the US amount to 393,663 metric tons, the equivalent of 98,415,754 kg boxes.

Nevertheless, according to the USDA/APHIS data obtained for exports during the 2020 season, 64,454,429 4kg boxes were exported with hot water treatment, the equivalent of 257,818 tons.

9.1.3.3 MANGOS WITH IRRADIATION TREATMENT

According to the information provided by CONASPROMANGO, there are 842 ha with mango production in Mexico from the States of Chiapas, Oaxaca, Michoacán and Colima, from which approximately 10,000 metric tons of mangos are exported with treatment by irradiation.

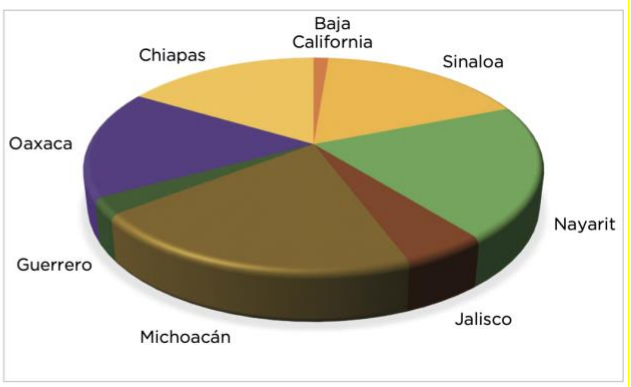
The USDA/APHIS reports that the exports for the 2020 season or 1,292,441 4kg boxes, the equivalent of 5170 metric tons.

There are 79 packing houses for mango exports with hot water treatment which, according to EMEX, are distributed as follows: (Refer to Table 7)

TABLE 7 / FIGURE 12:

PACKING HOUSES THAT EXPORT MANGOS WITH THE QUARANTINE HOT WATER TREATMENT. YEAR 2020

No.	ESTADO	CANTIDAD
1	Baja California	1
2	Sinaloa	14
3	Nayarit	16
4	Jalisco	4
5	Michoacán	16
6	Guerrero	2
7	Oaxaca	13
8	Chiapas	13
TOTAL		**79**



According to data obtained from the USDA /APHIS, mango exports from Mexico occur from the month of January and extends until September, that is, from week 1 to week 40. (Refer to Table 8)

TABLE 8:

WEEKLY EXPORTS FROM MEXICO TO THE US (4KG BOXES) YEAR 2020

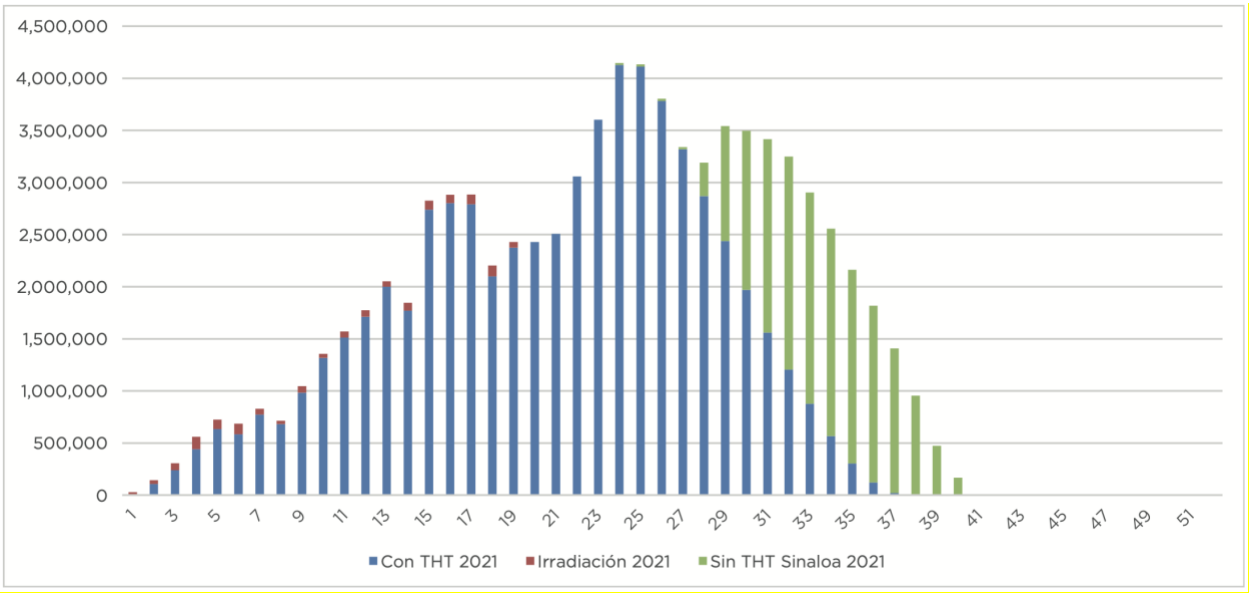
Week No.	With HWT 2021	Irradiation 2021	Without HWT Sinaloa 2021	TOTAL
1	9,570	20,164	0	29734
2	106,136	37,366	0	143502
3	238,712	67,251	0	305963
4	442,034	117,302	0	559336
5	633,581	90,782	0	724363
6	584,229	101,466	0	685695
7	772,984	56,299	0	829283
8	682,006	31,422	0	713428
9	983,183	63,547	0	1046730
10	1,315,968	40,624	0	1356592
11	1,513,076	57,057	0	1570133
12	1,711,590	63,859	0	1775449
13	2,000,943	51,072	0	2052015
14	1,771,106	76,071	0	1847177
15	2,739,434	85,931	0	2825365
16	2,802,452	80,088	0	2882540
17	2,791,265	93,795	0	2885060
18	2,099,407	104,465	0	2203872
19	2,375,595	53,880	0	2429475
20	2,428,610	0	0	2428610
21	2,507,985	0	0	2507985
22	3,059,000	0	0	3059000
23	3,603,422	0	0	3603422
24	4,127,115	0	20,730	4147845
25	4,111,774	0	22,042	4133816
26	3,782,798	0	21,424	3804222
27	3,319,112	0	20,143	3339255
28	2,869,392	0	320,861	3190253
29	2,439,021	0	1,101,944	3540965
30	1,968,940	0	1,527,948	3496888
31	1,560,531	0	1,855,177	3415708
32	1,203,820	0	2,045,248	3249068
33	876,117	0	2,029,188	2905305
34	565,950	0	1,991,046	2556996
35	303,561	0	1,858,786	2162347
36	121,966	0	1,696,055	1818021
37	20,152	0	1,387,948	1408100

38	9,000	0	946,204	955204
39	6,892	0	467,050	473942
40	6,000	0	161,409	167409
41	0	0		0
42	0	0		0
43	0	0		0
44	0	0		0
45	0	0		0
46	0	0		0
47	0	0		0
48	0	0		0
49	0	0		0
50	0	0		0
51	0	0		0
52	0	0		0
TOTAL	**64464429**	**1,292,441**	**17473203**	**83230073**

Source: *Research team*, based on data obtained from USDA/APHIS

FIGURE 13:

COMPARISON OF WEEKLY MANGO EXPORTS WITH IRRADIATION, WITH HWT, AND WITHOUT HWT



Source: *Research team, based on data obtained from USDA/APHIS*

TABLE 9:

MANGO HARVEST SEASONALITY IN MEXICO

MESES	ATAULFO	TOMMY	HADEN	KENT	KEITT
ENERO					
FEBRERO					
MARZO					
ABRIL					
MAYO					
JUNIO					
JULIO					
AGOSTO					
SEPTIEMBRE					
OCTUBRE					
NOVIEMBRE					
DICIEMBRE					

9.1.4 STATUS OF MEXICO IN THE FRUIT FLY PROGRAM (MOSCAFRUT).

9.1.4.1 Status of The MOSCAMED Program

The presence of Mediterranean fruit fly was officially reported by Mexico in 1977, having been detected for the first time in Tuxtla Chico, near the border with Guatemala. In 1978, the MOSCAMED program was created in Mexico, implementing detection, control, and eradication actions for the Mediterranean fruit fly on Mexican soil.

In 1982 (4 years after the initiation of the MOSCAMED program), the Ministry of Agriculture and Livestock in Mexico declared the eradication of the Mediterranean fruit fly in Chiapas, Mexico.

Since then, sporadic outbreaks of Mediterranean flies have been detected in the southeast and other Mexican States, but they've been successfully controlled and eradicated, maintaining the free area status for Mediterranean fruit fly

Maintaining Mexican territory free of the presence of the Mediterranean fruit fly, to a large extent, is a response to the successful result obtained in Guatemala, where they have been able to maintain a satisfactory containment barrier to preclude the pest from traveling along the continental path towards Mexico.

9.1.4.2 The MOSCAFRUT Program

In Mexico, the National Fruit Fly Program is made up of the Mediterranean Fruit Fly Program (MOSCAMED Program) headquartered in Tapachula, Chiapas, the Epidemiological Monitoring Of

Exotic Fruit Flies program, and the National Anti-Fruit Fly Campaign (CNMF) for the Anastrepha genus. The latter two have their administrative headquarters in Mexico City.

The National Anti-Fruit Fly Campaign (CNMF) started in Mexico in 1992 with the objective of controlling and eradicating four species of fruit flies: a) Anastrepha ludens, Anastrepha oblicua, Anastrepha stricta, and Anastrepha serpentina.

For this reason, the Ministry of Agriculture and Water Resources (SARH) and the Inter-American Institute for Cooperation on Agriculture signed a technical cooperation agreement for the National Anti-Fruit Fly Campaign, with the objective of administering the resources to fund the operations for this phytosanitary program.

In accordance with Federal Plant Health Law, the first agreement, through which fruit fly free areas were declared in Mexico, was published in the Federal Register on July 26, 1995, for the municipalities of Comondú, Mulegé and Loreto, in the state of Baja California Sur, 67 municipalities in the state of Sonora, and all the municipalities in the state of Chihuahua.

On September 29, 1995, two (2) municipalities from the state of Sonora were included and, on February 26, 1998, the States of Baja California, Baja California Sur, Chihuahua and Sonora were officially declared fruit fly free.

In 2001, the fruit fly free declarations were published for the municipalities of Ahome, Choix, El Fuerte, Guasave and Sinaloa de Leyva, in the state of Sinaloa, and all the municipalities in the state of Coahuila.

In 2004, thirty-two (32) municipalities in the state of Durango were declared fruit fly free. In 2005, the municipalities of Angostura, Badiraguato, Culiacán, Elota, Mocorito, Navolato and Salvador Alvarado, in the state of Sinaloa, were declared fruit fly free. (Refer to Tables 10 and 11).

9.1.4.3 International Recognition of Fruit Fly Free Areas

In 1998, the US Department of Agriculture (USDA) recognized the municipalities of Altar, Atil, Caborca, Carbó, Empalme, Guaymas, Hermosillo, Piquito, Plutarco Elías Calles, Puerto Peñasco, San Luis Río Colorado and San Miguel Horcasitas, in the state of Sonora, as the first fruit fly free zone at the international level.

In 1999, the USDA recognized the municipalities of Mulegé, Comondú and Loreto, in the state of Baja California Sur, six municipalities in the state of Sonora, and the municipalities of Bachiniva, Casas Grandes, Cuauhtémoc, Guerrero, Namiquipa and Nuevo Casas Grandes, in the state of Chihuahua.

On June 25, 2003, the USDA recognized the municipalities of La Paz and Los Cabos, in the state of Baja California Sur, and the municipalities of Ahome, Choix, El Fuerte, Guasave and Sinaloa de Leyva, in the state of Sinaloa.

TABLE 10:

FRUIT FLY FREE OR LOW PREVALENCE AREAS FOR MANGO PRODUCTION. YEAR 2021

No.	LUGARES (Estados, Provincias, Departamentos, Municipios, Cantones).	ESTATUS DEL AREA	AREA TOTAL (Has)	AREAS ACTUAL MANGO (Has)	Reconocimento EE.UU (USDA)	Declaratoria Oficial Nacional. (Ministerios de Agricultura).	Año
1	Estado de Sinaloa (12 municipios)	Libre	4,198,500	6,240	a) Ceratitis capitata b) Anastrepha ludens c) Anasatrepha oblicua d) Anastrepha striata e) Anastrepha serpentina		2003
	Estado de Sinaloa (6 municipios)	Libre Baja Prevalencia	1,626,500	25,566	Ceratitis capitata	A. ludens A. oblicua A. striata A. serpentina	
	Subtotal		**5,825,000**	**31,806**			
2	Nayarit	Libre	2,785,650	25,131	Ceratitis capitata		1982
3	Colima	Lbre	5,627	5,404			
4	Jalisco	Libre	7,859,590	9,264			
5	Michoacan	Libre	5,859,870	25,017			
6	Guerrero	Libre	6,359,590	24,847			
7	Oaxaca	Libre	9,375,760	16,881			
8	Veracruz	Libre	7,182,350	18,424			
9	Campeche	Libre	5,758,490	4,632			
10	Chiapas	Libre	7,331,100	30,814			
	Subtotal		**52,518,027**	**160,414**			
	TOTAL		**58,343,027**	**192,220**			

TABLE 11:

FRUIT FLY FREE OR LOW PREVALENCE AREAS FOR MANGO PRODUCTION. YEAR 2021

No.	LUGARES (Estados, Provincias, Departamentos, Municipios, Cantones).	ESTATUS DEL AREA	AREA TOTAL (Has)	AREAS ACTUAL MANGO (Has)	Reconocimento EE.UU (USDA)	Declaratoria Oficial Nacional. (Ministerios de Agricultura).	Año
11	Baja California	Libre	7,145,000	0	Ceratitis capitata		1985
12	baja California Sur	Lbre	7,390,940	1,681			1995
13	Chihuahua	Libre	24,741,260	0			1998
14	Sonora	Libre	17,935,470	136			2001
15	Coahuila	Libre	15,159,480	0			2004
16	Durango (32 municipios)	Libre	12,336,400	400			2006
17	Nuevo León (19 municipios)	Libre	6,415,620	0			2007
18	Zacatecas (36 municipios)	Libre	7,527,530	28			2008
19	San Luis Potosí (21 municipi	Libre	6,113,800	55			2009
	Subtotal		**104,765,500**	**2,300**			
20	Puebla		3,430,960	54	Ceratitis capitata		1982
21	Queretaro		1,169,060	77			
22	Morelos		487,890	337			
23	México		149,430	370			
24	Hidalgo		2,082,140	83			
25	Tamaulipas		8,024,930	858			
26	Tabasco		2,473,000	194			
27	Yucatán		3,952,440	152			
	Subtotal		**21,769,850**	**2,125**			
	TOTAL		**126,535,350**	**4,425**			

9.1.5 Work Plans for Fruit Exports from Fruit Fly Free Areas.

In 1989, the first work plan was signed between Mexico and the US to export fruit from the Sonora fruit fly free zone, which was endorsed in 1990 and 1997.

In 1999 and 2003, work plans were signed for the fruit fly free areas in Baja California Sur and Northern Sinaloa. On July 13, 2003, Mexico initiated mango exports to the US without the need to carry out the post-harvest hot water treatment.

Beginning during the first years since the US-Mexico agreement to export mangos from fruit fly free areas went into effect, the five municipalities in Northern Sinaloa exported an average of 30,000 metric tons per year and, during the 2018, 2019 and 2020 harvest seasons, exported an average in excess of 60,000 metric tons per year from the 5,680 hectares of mango production farmed in the municipalities of Ahome, Choix, El Fuerte, Guasave and Sinaloa de Leyva, in the State of Sinaloa.

On May 9, 2011, SAGARPA and USDA signed a work plan to establish fruit fly free production sites in the municipalities of General Terán and parts of Montemorelos for the purpose of exporting citrus to the US without the need for the application of the post-harvest quarantine treatment.

This plan represents an additional risk management option associated with fruit flies, especially for regions where ecological complexities limit the establishment of pest free areas.

9.2 GUATEMALA

9.2.1 CURRENT MANGO PRODUCTION AREAS IN GUATEMALA

According to data provided by the Office of Geographic, Strategic, and Risk Management Information (DIGEGR) of the Ministry of Agriculture, Livestock, and Food (MAGA), by 2015, there were 12,650 ha of mango production on Guatemalan soil.

The largest area of mango production, with 11,539 hectares (91.21%), is located on the Pacific coast, that from west to east includes the departments of San Marcos, Quetzaltenango, Retalhuleu, Suchitpéquez, Escuintla, Santa Rosa and Jutiapa.

The departments of Retalhuleu, Suchitepéquez and Escuintla, in the southwest portion of the country, have 7,753 ha of production (61.28%), the departments of Santa Rosa and Jutiapa, in the southeast portion of the country, have 2,133 ha of production (16.86%), and the rest of the areas with mango production are located in the departments of San Marcos and Quetzaltenango with a total of 1,653 ha (13.07%).

The largest concentration of mango production, 5,046 ha (39.89%), is in the department of Retalhuleu, with the municipalities of Champerico and Retalhuleu being the locations with the largest mango production areas.

Table 12 and Figure 14 show the distribution of the mango production areas in Guatemalan territory.

TABLE 12:

No.	DEPARTAMENTS	SIG-MAGA 2015	Percentage
1	Retalhuleu	5046	39.886175
2	Suchitepequez	1974	15.60351
3	Santa Rosa	1920	15.176666
4	Quetzaltenango	1418	11.2086
5	Escuintla	733	5.7940084
6	Zacapa	488	3.8574026
7	El Progreso	469	3.7072168
8	San Marcos	235	1.8575607
9	Jutiapa	213	1.6836614
10	Huehuetenango	103	0.8141649
11	Chiquimula	38	0.3003715
12	Chimaltenango	14	0.1106632
TOTAL		**12651**	**100**

FIGURE 14:

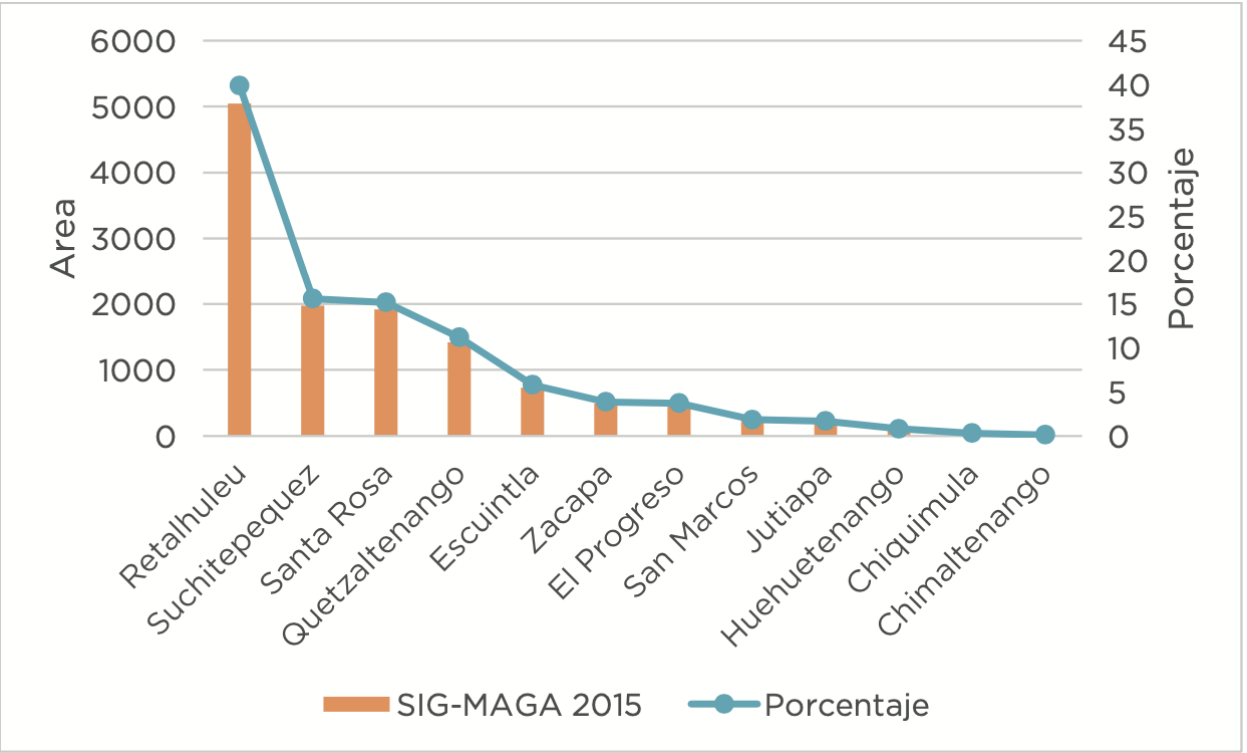


FIGURE 15:

MANGO PRODUCTION AREAS IN GUATEMALA

9.2.2 LOCATION OF MANGO PRODUCTION AREAS THAT EXPORT TO THE US

According to information provided by the Guatemalan Exporters Association Mango Committee (AGEXPORT), currently (year 2020), Guatemala has 2,300 ha of mango production with export quality registered.

This implies that in Guatemala, of the total area planted with mangos (12,651 ha), only 2,300 ha (18%) are focused on the production, harvest, and processing of fresh mangos for export to the US.

From 2015-2020, Guatemala exported to the US a yearly average of 3.7 million 4 kg boxes of fresh mangos, the equivalent of 14,800 metric tons per year.

The main mango production areas for export are found in the departments of Retalhuleu and Zacapa.

During the 2020 export season, 176 mango production farms were registered, of which 113 were located in Zacapa (64%), and 63 in Retalhuleu (36%).

Nevertheless, in terms of total area of export mangos harvested, Retalhuleu, despite having a lower number of farms (63), has a larger mango production area (1,379 ha), equivalent to 60% of the total area harvested.

9.2.3 MANGO EXPORT VOLUMES IN GUATEMALA

Guatemala has a total of six packinghouses that process fresh mangos for export. Of these, four (4) are certified to export to the US:

1. a) Amadeo Export, S.A: Located in Estanzuela, Zacapa.
2. b) Agroindustrias del Trópico, S.A: Located in Champerico, Retalhuleu.
3. c) Mangos de Guatemala, S.A.: Located in Champerico, Retalhuleu.
4. d) Frutico de Guatemala, S.A.: Located in Patulul, Suchitepéquez.

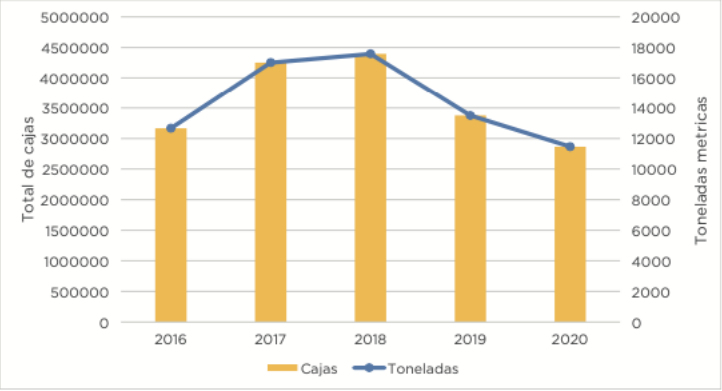
Dearing the 2016 – 2020 period, export to the US averaged 36 million 4 kg boxes per year, the equivalent of 14,444 metric tons per year.

TABLE 13:

MANGO EXPORTS FROM GUATEMALA TO THE US

Year	Metric Tons	4kg Boxes
2016	12666	3166475
2017	17005	4251236
2018	17581	4395292
2019	13506	3376970
2020	11460	2865026
TOTAL	**72218**	**18054999**
Average	14443.6	3611000

FIGURE 16:



Source: *Research team, based on information obtained from* AGEXPORT Mango Committee.

Mango production that is exported from Guatemala occurs during the period between weeks 8 and 23, that is, from the month of February to the month of June.

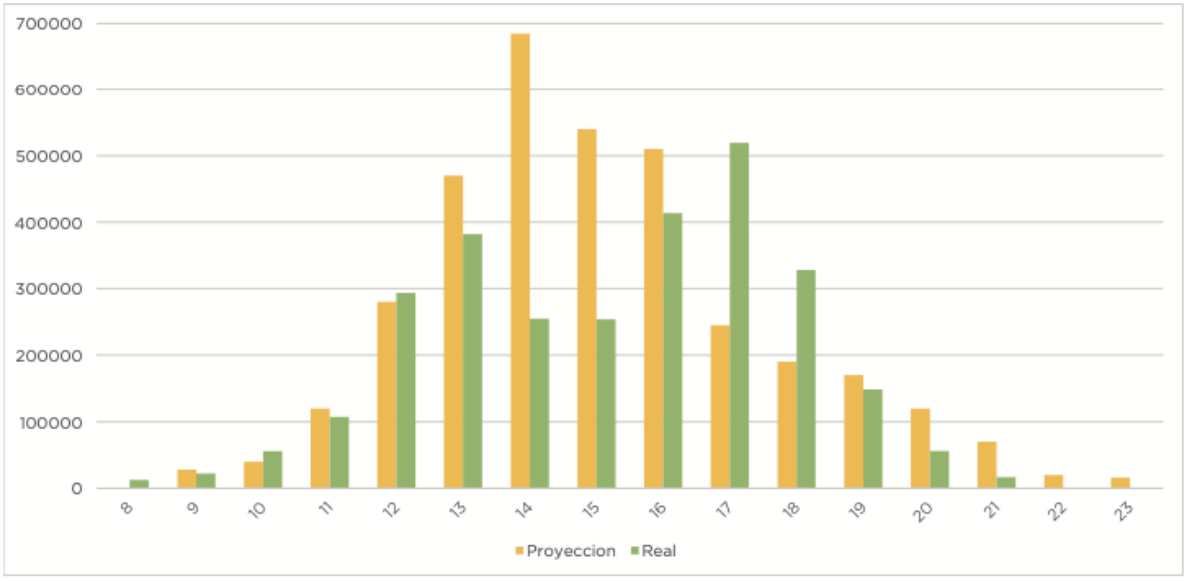
Table 14 and Figure 17 show that mango production, processing, and exports begin in Guatemala during the second half of the month of February and concludes during the last week of the month of May, with the period of mango exports to the US lasting approximately 14–16 weeks.

TABLE 14:

MANGO BOXES EXPORTED – WEEKS 8 TO 23 OF 2020

SEMANA No.	Proyeccion	Real
8	0	12568
9	28000	22243
10	40000	55680
11	120000	107352
12	280000	293730
13	470000	382061
14	685000	255000
15	540000	253868
16	510000	413564
17	245000	519308
18	190000	328308
19	170000	148544
20	120000	56000
21	70000	16800
22	20000	0
23	16000	0
Total	**3,504,000**	**2,865,026**

FIGURE 17:



***Source**: Research team, based on information obtained from* AGEXPORT.

9.2.4 STATUS OF GUATEMALA REGARDING THE FRUIT FLY PROGRAM (MOSCAFRUT)

9.2.4.1 Status of the MOSCAMED Program

The MOSCAMED program in Guatemala, after 44 years of operation, has led to the following results in terms of fruit fly free, low prevalence, and infested areas as shown in Table 15 and Figure 17.

TABLE 15:

STATUS OF THE MOSCAMED FRUIT FLY FREE AREA PROGRAM IN GUATEMALA, CENTRAL AMERICA. YEAR 2020

No.	Nombre	Area (km2)	Status fitosanitario
1	Peten	29,500	Reconocida internacionalmente por EE.UU y Mexico
2	Los Huistas	2,287	Declarada oficialmente por el MAGA
3	Salcaja	710	Declarada oficialmente por el MAGA
4	Champerico	1,074	Declarada oficialmente por el MAGA
5	Resto de Area Libre	9,101	Establecida internamente por Programa Moscamed
TOTAL		**42672**	

FIGURE 17:

MEDITERRANEAN FRUIT FLY FREE AREAS

FIGURA 17:
ÁREAS LIBRES DE LA PRESENCIA DE MOSCA DEL MEDITERRÁNEO

With regard to Figure 17, consideration needs to be given to the fact that the MOSCAMED fruit fly free area, highlighted in green, shows three conditions of phytosanitary status:

***Area 1:** Mediterranean fruit fly free area, internationally recognized by the* USDA (US).

***Area 2:** Mediterranean fruit fly free area*, declared by the Ministry of Agriculture, Livestock, and Food (MAGA).

***Area 3:** Mediterranean fruit fly free area*, established domestically by the MOSCAMED program.

The low prevalence area, highlighted in purple, refers to periods when the infestation of the pest was below 0.01 FTD (flies per trap per day).

The area highlighted in yellow refers to infested areas where control and monitoring work is being undertaken.

The rest of the country is highlighted in gray, which are infested areas without monitoring or control.

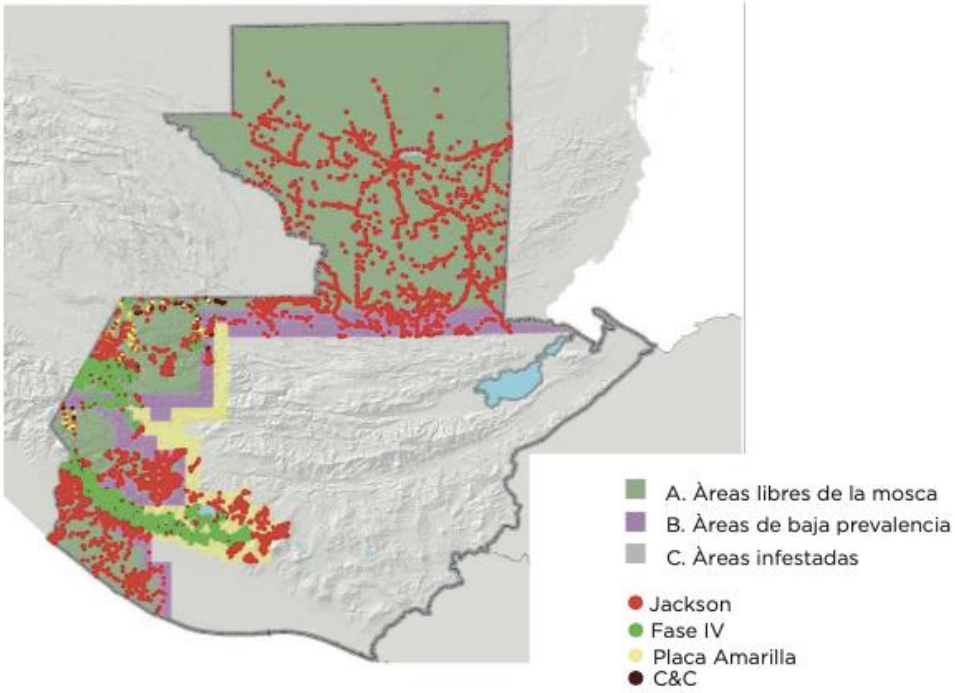
9.2.4.2 The MOSCAFRUT Program

The MOSCAFRUT program was implemented in Guatemala in 2010, and currently maintains monitoring activities in some areas located in the southwest and southeast regions of Guatemala, however, there is no official status ascribed to any area officially deemed to be of free or low prevalence to the presence of the Anastrepha species.

In 2020, the MOSCAFRUT program in Guatemala implemented a network of 1,185 traps in operation (refer to map in FIG. 18). To date, the MOSCAFRUT program has not established any area in Guatemalan territory considered to be of free or low prevalence to the presence of the Anastrepha species.

FIGURE 18:

GRAPH SHOWING DISTRIBUTION OF THE MOSCAFRUT TRAPPING NETWORK



Source: MOSCAFRUT Program in Guatemala.

9.3 ECUADOR

9.3.1 MANGO PRODUCTION AREAS IN ECUADOR

In Ecuador, according to data provided by the Ministry of Agriculture, Livestock, Aquaculture, and Fishing (MAGAP), 10,000 ha are currently farmed, of which approximately 5,377 ha (54%) are set aside for the production of export quality mangos and are located primarily in the provinces of Guayas (70%), Los Ríos (10%), Manabí (10%) and El Oro (10%).

In the province of Guayas, the largest share of mango production is found in the Cantons and Parishes of Chongon, El Consuelo, El Empalme and Palestina.

FIGURE 19:

MANGO PRODUCTION AREAS IN ECUADOR. YEAR 2021.

Source: Research team, based on source from MAGAP.

FIGURE 20:

PROVINCE OF GUAYAS, LARGEST SHARE OF MANGO PRODUCTION IN ECUADOR. YEAR 2021

The export varieties that are farmed include: Tommy Atkins (56.5%), Haden (21%), Kent (14.1%), Edward (2.2%), Keitt (1.9%) and Ataulfo (0.5%).

The harvest season occurs between the end of the month of September and the month of February.

FIGURE 21:

MANGO PRODUCTION ZONE IN ECUADOR.

(GUAYAS: EL CONSUELO, CHONGÓN, PALESTINA, EMPALME)

Source: Research team, based on google earth search.

9.3.2 LOCATION OF MANGO PRODUCTION AREAS THAT CURRENTLY EXPORT TO THE US.

According to the information provided by *Fundación Mango del Ecuador* (FME), at present, Ecuador has 5,377 ha registered for the production of export quality mangos that are shipped to the US, of which 98% correspond to the province of Guayas.

This implies that of the total area of mango production planted (10,000 ha), only 5377 ha (54%) are set aside for the production, harvest, and processing of fresh mangos for export to the US.

From 2020-2021, Ecuador exported to the US a yearly average of 12.25 million 4kg boxes of fresh mangos, the equivalent of 49,000 metric tons per year, from 87 farms where fruit fly behavior is under constant monitoring.

The main production areas for export mangos are located in the regions of Guayas, Manabí, Los Rios and Oro, on the Pacific coastline.

9.3.3 MANGO EXPORT VOLUMES IN ECUADOR.

During the 2020-2021 season, Ecuador exported a total of 49,000 metric tons of mangos to various destinations, of which 46,110 metric tons were exported to the US, the equivalent of 94% of total exports.

Table 1 shows the distribution of the export destination for the mangos harvested and processed in Ecuador.

During the period between the year 2000 and the year 2020, the exportable production of mangos from Ecuador has ranged between 20,777 metric tons in the year 2003 and 51,099 metric tons in the year 2007, which gives us a yearly average of exports during those 20 years of 40,653 metric tons.

Nevertheless, over the last three seasons 2018/2019, 2019/2020, and 2020/2021, a yearly average of 12.9 million 4kg boxes have been exported, the equivalent of 51,575 metric tons. (Refer to Table No. 16).

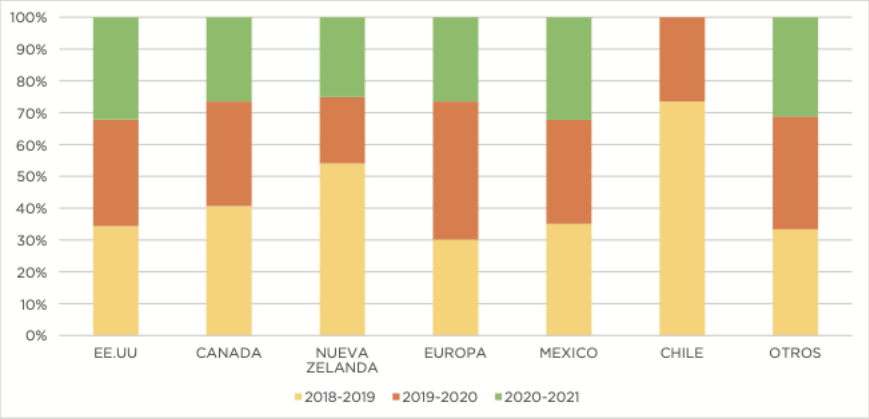
TABLE 16:

HISTORY OF MANGO EXPORTS IN ECUADOR. 2018-2020 / 4kg BOXES

No.	DESTINATION	2018-2019	2019-2020	2020-2021	TOTAL	AVERAGE	PERCENTAGE
1	EE.UU	12,319,698	11,997,392	11,527,440	35,844,530	11948177	92.6662366
2	CANADA	487,496	394,888	317,153	1,199,537	399845.7	3.1010751
3	NUEVA ZELANDA	217,468	84,000	100,800	402,268	134089.3	1.03995398
4	EUROPA	186,013	269,077	163,477	618,567	206189	1.59913593
5	MEXICO	109,760	102,285	100,958	313,003	104334.3	0.80918372
6	CHILE	127,680	46,032	0	173,712	57904	0.4490849
7	OTROS	43,299	46,011	40,400	129,710	43236.67	0.33532976
TOTAL		**13,491,414**	**12,939,685**	**12,250,228**	**38,681,327**	**12893776**	**100**

FIGURE 22:

HISTORY OF MANGO EXPORTS 2018-2020 ECUADOR / 4kg BOXES



Ecuador has a total of five certified processing plants for exporting fresh mangos, 4 of which are certified for export to the US. (Refer to Table 17)

Table 17 shows the respective share of total mango exports of the main Ecuadorian companies.

With Agriproduct, Bresson, Dining, Dureexporta, and Somecet, being the companies that export fresh mangos to the US.

TABLE 17:

MAIN MANGO EXPORTERS IN ECUADOR. YEAR 2021

No.	COMPANY	BOXES	%
1	Agriproduct	4,384,913	35.7945
2	Durexporta	4,084,487	33.3421
3	Bresson	2,384,756	19.467
4	Dining	1,312,392	10.7132
5	Somecet	83,680	0.68309
	TOTAL	**12,250,228**	**100**

FIGURE 23:

PERCENTAGE OF MANGO BOXES EXPORTED FROM ECUADOR. YEAR 2021

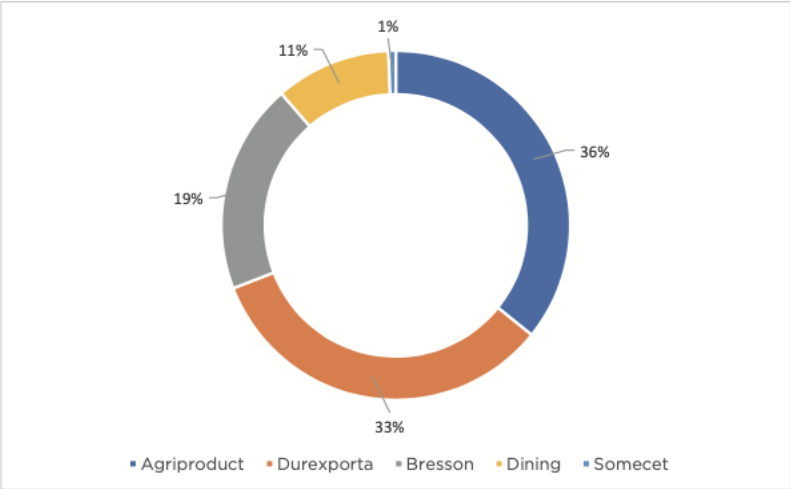
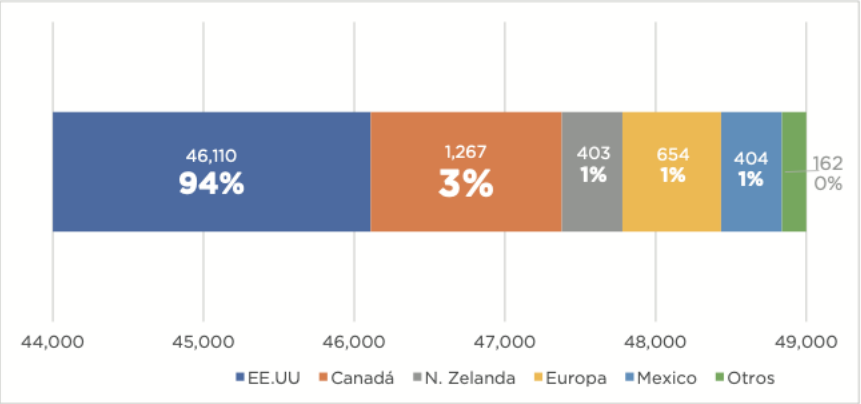


TABLE 18:

EXPORT VOLUME TO VARIOUS DESTINATIONS FROM ECUADOR. YEAR 2020-2021

No.	COUNTRY	Metric Tons	Percentage (%)
1	EE.UU	46,110	94.1
2	Canadá	1,267	2.59
3	N. Zelanda	403	0.82
4	Europa	654	1.34
5	Mexico	404	0.82
6	Otros	162	0.33
TOTAL		**49,000**	**100**

FIGURE 24:



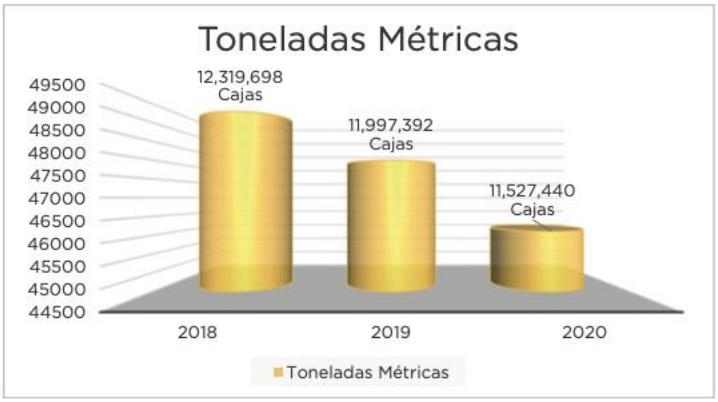
During the period from the year 2018 to the year 2020, a yearly average of 11.9 million 4kg boxes were exported to the US, the equivalent of 47,793 metric tons per year (Refer to Table 19 and Figure 25).

TABLE 19:

MANGO EXPORTS FROM ECUADOR TO THE US

Year	Metric Tons	4kgs Boxes
2018	49278.8	12,319,698
2019	47989.6	11,997,392
2020	46109.8	11,527,440
TOTAL	**143378**	**35844530**
Average	**47792.7**	**11948176.7**

FIGURE 25:



Exports of mango production from Ecuador occur during the period between week 38 and week 2, that is, from the month of October to the month of January.

Starting from a yearly average of 12.9 million 4kg boxes that were exported from Ecuador over the last three years, Table 20 and Figure 26 show the weekly behavior of these exports.

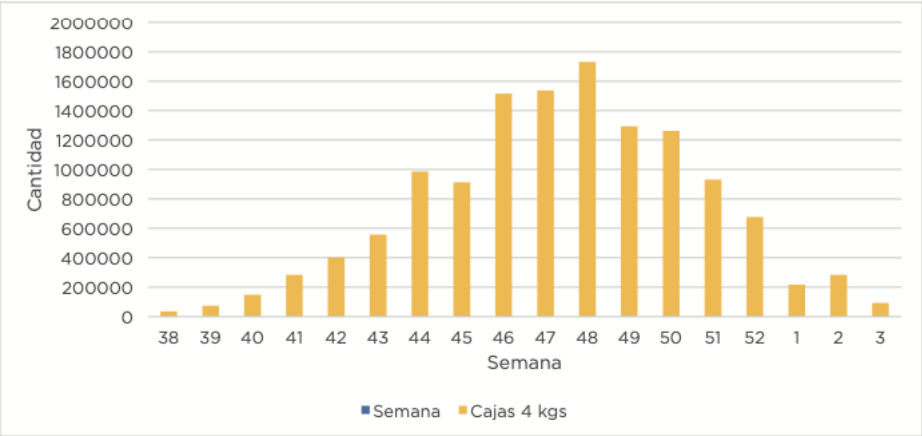
TABLE 20:

WEEKLY BEHAVIOR OF MANGO EXPORTS, ECUADOR

Week	4kg Boxes	%
38	35,656	0.2755554
39	74,036	0.5721623
40	148,609	1.1484746
41	283,230	2.1888477
42	402,281	3.1088933
43	556,614	4.3016039
44	985,934	7.6194591
45	912,377	7.0509985
46	1,515,962	11.715602
47	1,536,865	11.877144
48	1,731,311	13.379854
49	1,293,428	9.9958229
50	1,261,764	9.7511184
51	931,646	7.1999125
52	676,250	5.2261705
1	216,352	1.6720036
2	284,046	2.1951539
3	93,324	0.7212231
TOTAL	**12,939,685**	**100**

FIGURE 26:

WEEKLY BEHAVIOR OF MANGO EXPORTS, ECUADOR



Source: *Research team.*

9.3.4 CURRENT STATUS OF THE FRUIT FLY PROGRAM IN ECUADOR (MOSCAFRUT).

9.3.4.1 Background

According to J. Aldrich, the presence of fruit flies in Ecuador has been reported since 1925.

Since 1959, Ecuador has conducted studies for the purpose of understanding fruit fly species and ways to undertake measures to manage and control them.

In 1976, Mediterranean fruit flies (Ceratitis capitata) entered through the southern border, affecting the phytosanitary problems in the Ecuadorian fruit farming sector.

In the beginning, the problems caused by fruit flies caught the attention of fruit farmers in the inter-Andean region but, currently, the 10,000 ha of mango farms set aside for the export market in Guayas and Los Ríos have required the interest of producers due to the rigorous measures imposed by countries that buy the fruit.

The first campaign against fruit flies in Ecuador was carried out in the Cantons of Paute and Gualaceo, in November of 1965 (NEIRA, 1982), and was led by Ing. Lucio Vivar and Alfonso Altamirano, as well as agronomical engineers Guillermo León and Jorge Vidal.

During the 1980s, it was well known that Ecuador had the presence of 11 species of the Anastrepha genus.

In 1992, a determination was made in Ecuador that the most important species of fruit flies are: Anastrepha fraterculus Wiedemann and Ceratitis capitata (Wied.), (Molineros, Tigrero and

Sandoval, 1992). However, by 1992 there were at least 28 species of the Anastrepha genus reported to be present.

In 1998, a review was carried out of the fruit fly species that were present in Ecuador, and there were reports of 31 species of the of the Anastrepha genus, Toxotrypana recurcauda, and Ceratitis capitata.

The new species of Anastrepha amaryllis was described.

The reported species are: A. nambacoli (=A. macrura), A. grandis, A. atrox, A. concava, A. monteu, A. amaryllis, A. ornata, A. serpentina, A. striata, A. sp. posible integra, A. townsendi, A. nigripalpis, A. buski, A. mucro- nota, A. debilis, A. sp. cercana a debilis, A. crebra, A. obliqua, A. sororcula, A. fraterculus, A. bahiensis, A. distincta, A. sp. cercana a distincta, A. pseu- doparallela, A. sp. cercana a barnesi, A. leptozona, A. dryas, A. chiclayae, A. manihoti, A. rheediae, and A. tecta (Tigrero, 1998).

In the technical report entitled "Generation of technological alternatives for fruit fly control along the Ecuadorian coastline" they report the presence in Guayas of A. dissimilis, A. pickeli, and A. antunesi (Arias, 2003).

In 2005, a description was made of Anastrepha punensis (Tigrero and Salas, 2005). In 2006, a determination and description of A. sachay A. vermespinata (Tigrero and Salas, 2006). In 2007, a description was made of A. trimaculatay A. tumbalai (Tigrero and Salas, 2007). A. tsachila, A. rollinianay A. mikuymono (Tigrero, 2007) In 2009, a description was made of A. asetaocelata (Tigrero and Salas, 2009).

Currently, Ecuador reports a total of 37 species of Anastrepha.

The fruit flies of the Anastrepha Schiner genus are native to the American continent.

As observed, Ecuador is a center for various species of flies belonging to this genus (Korytkowski, 1992), the Amazon region being the principal one, but according to the most recent results obtained regarding new species that have been described (Tigrero 2006, 2007, and 2009), the coastline has also recorded four (4) new species for science, most of them found in the Guayas province. This is due to the fact that it is the only area that maintains constant monitoring as a result of the mango production for export operations located there.

If, indeed, there was a determination that the most important species of the Anastrepha genus is A. fraterculus, given that it attacks hosts of economic importance as well as its wide distribution, the Mediterranean fly is currently distributed in practically all the fruit farming/production zones of economic importance, which has obliged the countries that buy fruit products to demand quarantine measures for the purchase of fruits (AGROCALIDAD, 2010).

In 2008, the presence of Ceratitis capitata was identified for the first time in Isla San Cristóbal, it was observed later on in Santa Cruz, Isabela, and Floreana, which led to the initiation of eradication measures for this species in the Galapagos islands for the purpose of avoiding the dissemination and the establishment of this pest.

In 2008, by Executive Decree No. 1449, dated December 2, the Ecuadorian Agricultural Health Service was reorganized and became the Ecuadorian Agency for Agricultural Quality Assurance, currently known as AGROCALIDAD, a public technical agency with legal authority and standing, self-funded and capitalized, decentralized, with administrative, economic, financial and operational independence, and with jurisdiction over the entire Ecuadorian territory.

AGROCALIDAD took on the role of National Phytosanitary Protection Organization as the responsible agency in charge of developing the different official standards related to phytosanitary management that are demanded by international trade.

The Agency for Regulation and Control for Bio Security and Quarantine for Galapagos (ABG), along with AGROCALIDAD in Ecuador, establish the appropriate mechanisms to ensure the marketing of agricultural products that are free of any pests.

For this reason, AGROCALIDAD and ABG decided to implement a National Fruit Fly Project for the purposes of monitoring, controlling, and/or eradicating this species and, in this way, offer products that are free of fruit flies to be able to access new international markets as well as avoid the economic losses caused by these pests.

On December 31, 2013, the National Planning and Development Secretariat of Ecuador, by way of File No. SGPBV-2013-1419-07, approved the national fruit fly management project in Ecuador.

In 2014, the approval was issued for the execution of the "National Fruit Fly Management Project in Ecuador (PNMMF)", in the provinces of Pichincha, Chimborazo, Imbabura, Cotopaxi, Tungurahua, Santa Elena, Guayas, Manabí, Los Ríos, Santo Domingo de los Tsáchilas, Morona Santiago, Napo, Bolívar, Azuay and Carchi.

This project contemplates the execution of the following components: Diagnostic and Monitoring, Quarantine, Pest Management in the Field, Analytical Capacity, Awareness, and Dissemination.

The project was planned with an execution timeline of four years and with budget of US$64,523,316 (Sixty-four million, five hundred and twenty-three thousand, and three hundred and sixteen dollars).

9.3.4.2 Results Obtained:

In 2013, through resolution DAJ-2013465-0201.0224 issued on November 25, a declaration was made that the canton of Mejía, a low fruit fly prevalence area (Ceratitis capitata) where there are production sites for Peruvian groundcherries (Physalis peruviana) that are free from the aforementioned pest, was a risk management alternative for the compliance of phytosanitary requirements for export.

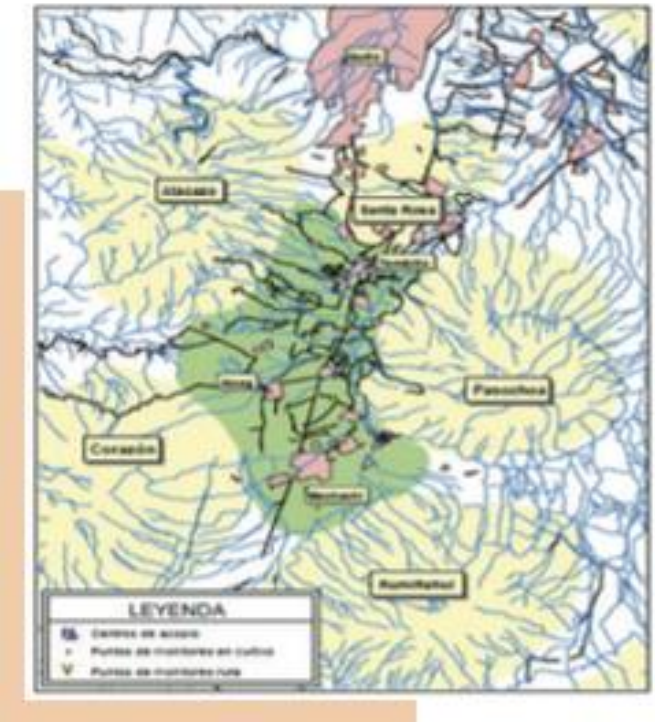
In the Galapagos islands, the levels of fruit fly infestation are considered of low prevalence, given that its FTD (Flies/Trap/Day) values are below 0.01.

In Santa Cruz the index is 0.006, San Cristóbal is 0.003, Isabela 0.001 and Floreana 0.0, which means that the populations of fruit flies are under control and in small numbers.

FIGURE 27:

LOW PREVALENCE AREA FOR CERATITIS CAPITATA IN VALLE DEL CANTÓN MEJÍA, ECUADOR

Source: AGROCALIDAD.



9.3.4.3 Current Status

FIGURE 27:

LOW PREVALENCE AREA FOR CERATITIS CAPITATA IN VALLE DEL CANTÓN MEJÍA, ECUADOR

Source: AGROCALIDAD.

The ABG is executing an integrated management plan for fruit flies in the Galapagos islands, which among the activities includes the application of toxic bait to trees, collection and elimination of fruits, and exposure of pupas.

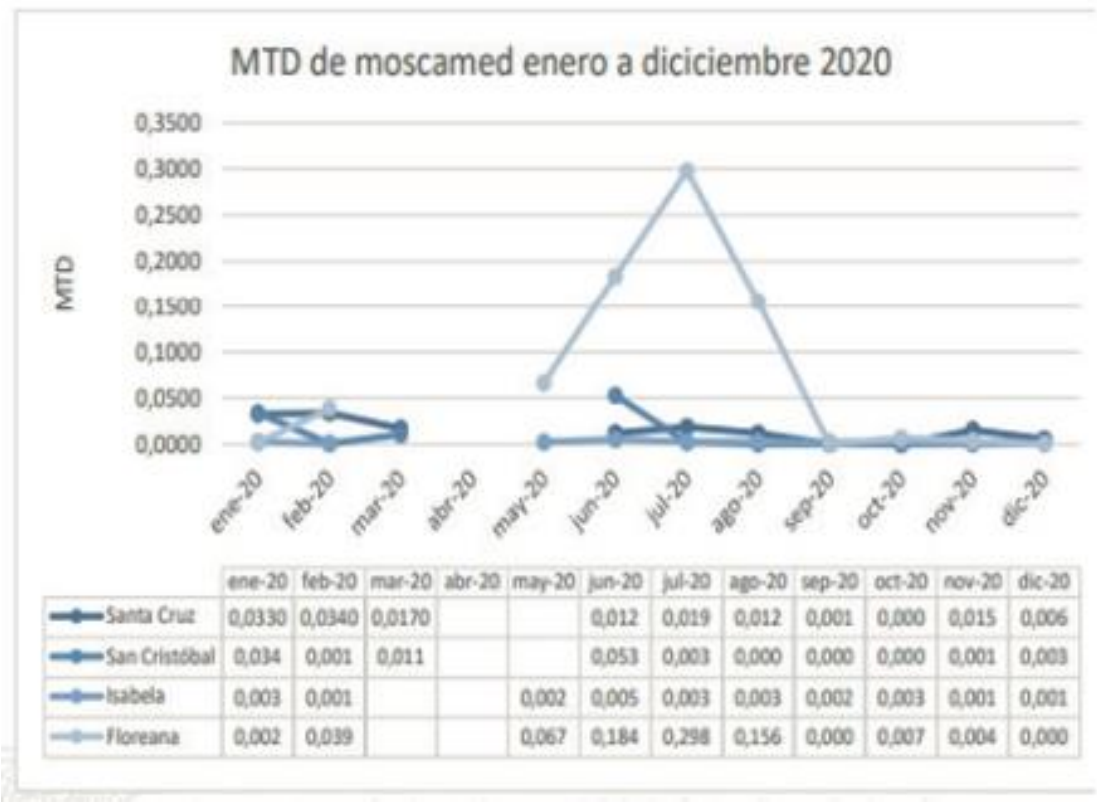
The agency operates monitoring points on five islands, which are used for the timely detection of the presence of quarantine fruit flies or the verification of the integrated control effectiveness.

The number of monitoring points is distributed in the following way: San Cristóbal has 172 monitoring points, Santa Cruz 263, Floreana 25, Isabela 25 and Santa Fe 25.

In the Floreana, Isabela and Santa Fe islands, the presence of Ceratitis capitata has not been detected.

Figure No. 28 shows the behavior of the MOSCAMED populations during the year 2020.

FIGURE 28:



	ene-20	feb-20	mar-20	abr-20	may-20	jun-20	jul-20	ago-20	sep-20	oct-20	nov-20	dic-20
Santa Cruz	0,0330	0,0340	0,0170			0,012	0,019	0,012	0,001	0,000	0,015	0,006
San Cristóbal	0,034	0,001	0,011			0,053	0,003	0,000	0,000	0,000	0,001	0,003
Isabela	0,003	0,001			0,002	0,005	0,003	0,003	0,002	0,003	0,001	0,001
Floreana	0,002	0,039			0,067	0,184	0,298	0,156	0,000	0,007	0,004	0,000

The first time that the release of sterile flies was conducted was 2018 in Santa Cruz and San Cristóbal, an action that was executed beginning on November 12 with the release of a total of 14,500,000 flies, until May 2019 during the first phase. The second phase was executed in October 2019 using the technique of releasing sterile flies in Santa Cruz and San Cristóbal and, for the first time, in Isabela and Floreana. From 2019 to March 2020 with a total of 13´050.000 sterile flies in the four Galapagos islands.

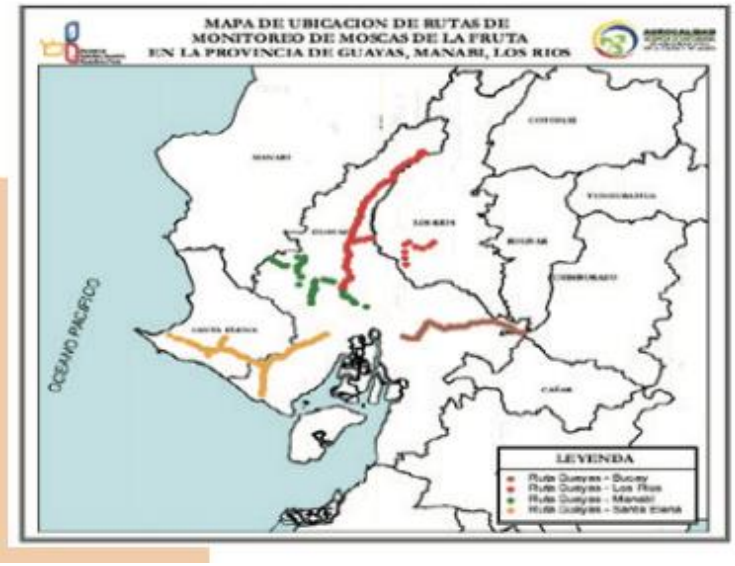
Sustained monitoring efforts, as well as some control practices, are conducted In mango production areas, whereas in the rest of the fruit farming areas not set aside for export no controls are carried out (AGROCALIDAD, 2010).

In the provinces of Guayas, Santa Elena, Manabí and Los Ríos, AGROCALIDAD has 232 monitoring points with Mcphail traps used for monitoring fruit flies.

In the mango producing areas for export in the provinces of Guayas, Los Ríos and El Oro, there are approximately 8,000 monitoring points for the detection of fruit flies with Jackson and McPhail traps, to be in compliance with the requirements imposed by the United States for mango exports.

FIGURE 29:

FRUIT FLY MONITORING ROUTES IN MANGO PRODUCTION REGIONS IN ECUADOR.



Source: AGROCALIDAD.

9.3.4.4 Projections

Mango growers and exporters that ship product from Ecuador to the US maintain the work plan between the Ecuadorian Agricultural Quality Assurance Agency (AGROCALIDAD) and the US Animal and Plant Health Inspection Service (APHIS), in which it establishes the participation of Fundación Mango del Ecuador (FME).

On the Pacific coast, where mangos are produced and exported, there are five important species of fruit flies: Anastrepha frateculus, Anastrepha oblicua, Anastrepha striata, Anastrepha serpentina and Ceratitis capitata.

9.4 PERU

9.4.1 MANGO PRODUCTION AREAS CURRENTLY IN PERU

According to the information provided by the Ministry of Agriculture and Irrigation (MINAGRI) and the Peruvian Association of Mango Producers and Exporters (APEM), in 2016 and 2020 there were mango production areas of 31,719 ha and 34,581 ha, respectively, in Peruvian territory.

Table 21, Figure 30, and Figure 31 show the distribution of mango production areas in Peruvian territory, according to information obtained from MINAGRI.

Figure 30 shows that there are three areas where mangos are grown and harvested in Peru.

Along the Pacific coast, that from north to south includes the regions of Tumbes, Piura, Lambayeque, Cajamarca, La Libertad, Áncash, Lima, Ica, Arequipa, Moquegua and Tacna, is where the largest area of mango production is currently located in Peru, 29,947 ha (94.44%). The remaining area, with 5.66%, is located in the region described in Table 21.

In the Pacific North region is where the largest areas of mango production are located, covering a total of 28,411 ha, the equivalent of 89.6% of the total area planted in Peru.

Two regions, Piura and Lambayeque, are where the highest concentrations of mango production are located in Peru, covering 81% of the total, and Piura being the region with the largest surface area of mango production in Peru with 21,282 ha, the equivalent of 67% del total.

TABLE 21:

MANGO PRODUCTION AREAS, GEOGRAPHIC DISTRIBUTION

No.	REGIONES	AREA (Has)	Porcentaje (%)
I. LITORAL PACIFICO			
1.1	**NORTE**		
1	Tumbes	82	
2	Piura	21,282	67.0954318
3	Lambayaque	4,549	14.3415618
4	Cajamarca	1,251	3.94400832
5	La Libertad	282	
6	Ancash	965	3.04234055
	Subtotal	**28411**	**89.5709196**
1.2 CENTRO			
7	Lima	792	
8	Ica	722	
	Subtotal	**1514**	4.77316435
1.3	**SUR**		
9	Arequipa	12	
10	Moquegua	10	
11	Tacna	0	
	Subtotal	**22**	
	TOTAL LITORAL	**29947**	**94.413443**
II.			
12	Amazonas	119	
13	San Martín	109	
14	Huanuco	98	
15	Pasco	6	
16	Junin	236	
17	Huancavelica	20	
18	Apurimac	79	
19	Ayacucho	68	
	Subtotal	**735**	**2.31722312**
III.			
20	Loreto	312	
21	Ucayali	494	
22	Cuzco	198	
23	Madre de Dios	33	
24	Puno	0	
	Subtotal	**1037**	**3.26933384**
TOTAL GENERAL		**31719**	**100**

Source: Research team, based on data obtained from MINAGRI.

FIGURE 30:

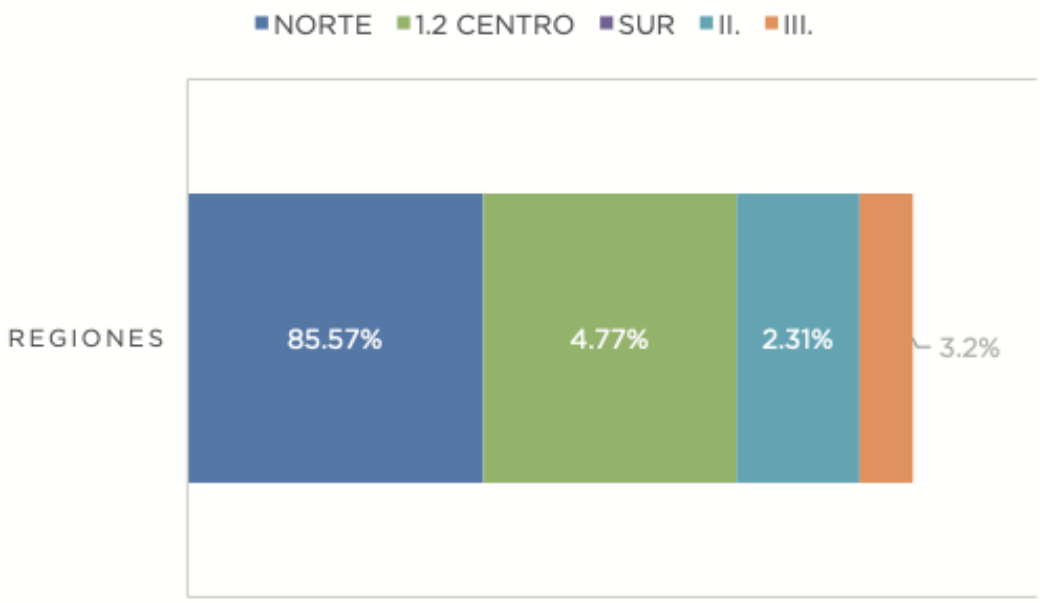


FIGURE 31:

MANGO PRODUCTION ZONE IN PERU.

Source: Google earth

For Peru, you can see in Table 22 and Figure 32 the historical behavior of the mango production area for the period from 2000 to 2019.

TABLE 22:

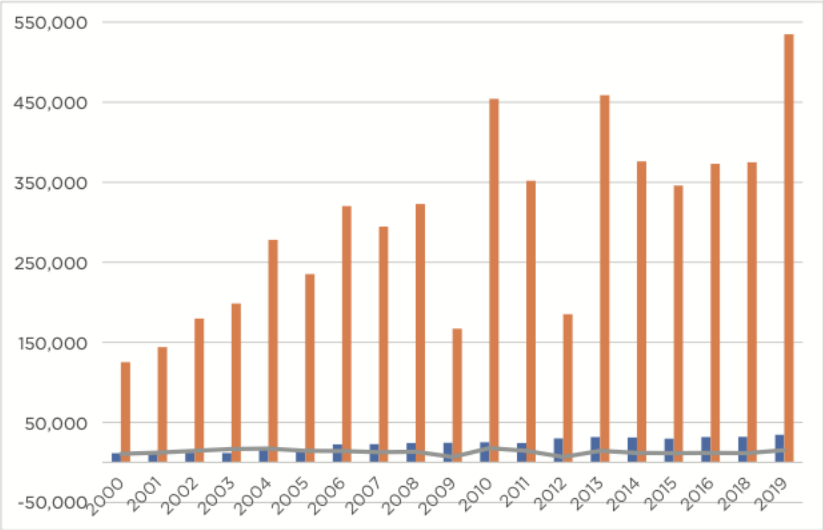
HISTORICAL BEHAVIOR OF MANGO PRODUCTION AREAS, PERU 2021

Year	Area Harvested (hectares)	Production	Yield (Kg/Ha)
2000	11,518	125,185	10,869
2001	11,809	144,130	12,205
2002	12,409	179,627	14,475
2003	11,768	198,490	16,867
2004	15,897	277,899	17,481
2005	16,126	235,406	14,598
2006	22,647	320,267	14,142
2007	22,936	294,440	12,838
2008	24,366	322,721	13,245
2009	24,702	167,008	6,761
2010	25,230	454,330	18,008
2011	24,373	351,937	14,440
2012	29,983	185,182	6,863
2013	31,741	458,766	14,454
2014	31,183	375,998	12,058
2015	29,733	345,979	11,636
2016	31,719	372,901	11,832
2018	32,000	375,000	11,719
2019	34,581	535,000	15,471
TOTAL	**249,962**		
MEDIA	**13,156**		

Source: *Research team, based on information obtained from* MINAGRI and APEM.

FIGURE 32:

HISTORICAL BEHAVIOR OF THE MANGO PRODUCTION AREAS IN PERU, PERIOD 2000-2019



Source: *Research team, based on information obtained from* MINAGRI and APEM.

9.4.2 LOCATION OF THE MANGO PRODUCTION AREAS THAT CURRENTLY EXPORT TO THE US.

According to information provided by the Peruvian Association of Mango Producers and Exporters (APEM), at present, Peru has 8,810 ha of export quality mango production that can be shipped to the US.

In Peru, this implies that of the total area of mango crops planted (34,581 ha), only 8,810 ha (25%) are set aside for the production, harvest, and processing of fresh mangos for export to the US.

During the 2019-2020 period, Peru had exported a yearly average of 18.7 million 4kg boxes of fresh mangos to the US, the equivalent of 74,882 metric tons per year.

The main mango production areas for export are located in the regions of Piura and Lambayeque, in the northern Pacific coast region of Peru.

Table 23 and Figure 33 show that for the 2019-2020 export season, the Ancash region experienced a considerable increase in mango production area, compared to what MINAGRI reported in 2016, expanding from 965 ha to 5,749.70 ha (Source: APEM).

TABLE 23:

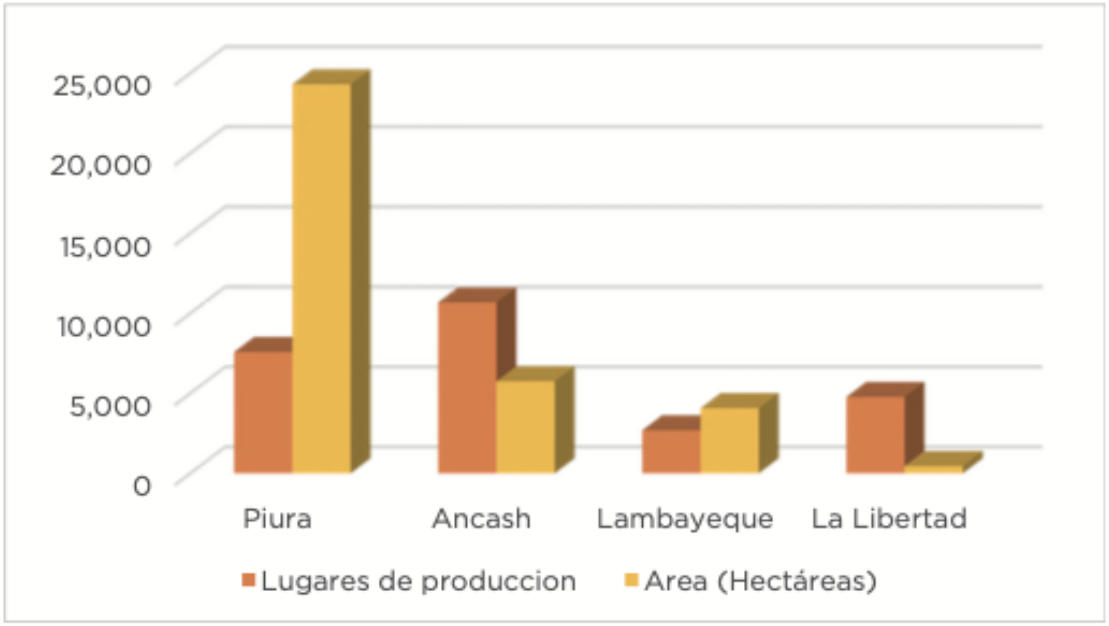
MANGO PRODUCTION AREAS REGISTERED FOR EXPORTS TO VARIOUS DESTINATIONS FROM PERU, 2020

No.	Region	Production Locations	Area (Hectares)	Average Ha/PL
1	Piura	7,579	24,304.21	3.20678322
2	Ancash	10,680	5,749.70	0.53836142
3	Lambayeque	2,688	4,070.93	1.51448289
4	La Libertad	4,769	456.36	0.09569302
TOTAL		**25,716**	**34,581.20**	1.3447348

Source: *Research team, based on information obtained from* APEM.

FIGURE 33:

HISTORICAL BEHAVIOR OF THE MANGO PRODUCTION AREAS IN PERU, PERIOD 2000-2019.



During the 2019-2020 export season, 25,716 production sites were registered, with the largest percentages of area and registered sites located in Piura, Ancash and Lambayeque.

Nevertheless, in terms of total mango area harvested for export, Piura has a larger mango production area (24,304 ha), the equivalent of 70% of the total area harvested.

FIGURE 34:

THE DEPARTMENT OF PIURA, THE LARGEST PRODUCER OF MANGOS IN PERU

FIGURE 35:

DISTRICTS IN THE PROVINCE OF PIURA

According to the Ministry of Agriculture and Irrigation (MINAGRI), the department of Piura has become one of the regions with the largest production of fruits and vegetables, where the National Agricultural Health Service (SENASA) certified 93,581 tons of mangos, of which 73,327 tons correspond to Tambo grande (78%), 19,272 tons to Sullana, and 982 tons to Chulucanas.

The Tambo Grande district is located on the right margin of the Piura River, approximately 60 km from the city of Piura and 100 km from the Paita seaport. It is at an altitude of 68 m above sea level, has a surface area of 1,442,81 km², and an average medium annual temperature of 24° C.

The San Lorenzo valley, where Tambo Grande is located, has 42,000 ha of agricultural production, predominantly areas where mangos are produced and harvested.

9.4.3 MANGO EXPORT VOLUMES IN PERU.

During the 2019-2020 season, Peru exported a total of 215,840 metric tons of mangos to various destinations by sea, of which 74,882 metric tons were exported to the US, the equivalent of 34.69% of total exports.

Table 24 shows the distribution of export destinations for mangos harvested and processed in Peru.

TABLE 24:

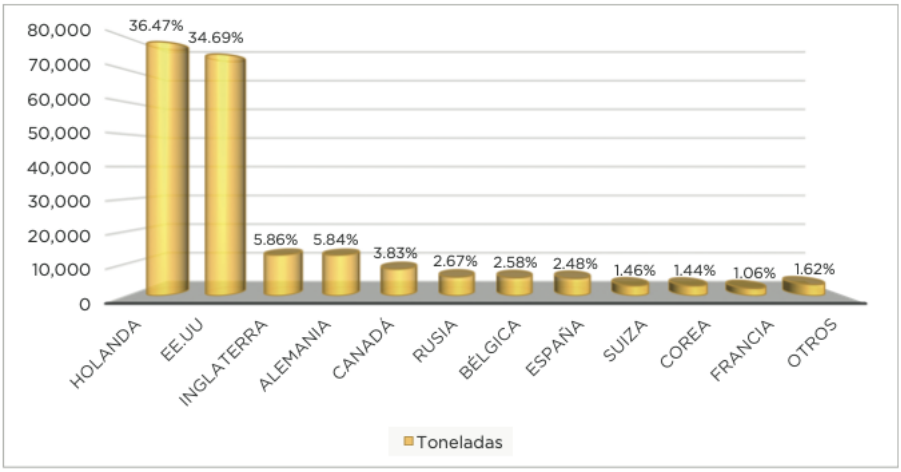
VOLUME OF EXPORTED MANGOES TO VARIOUS DESTINATIONS FROM PERU. YEAR 2020

	COUNTRY	Metric Tons	Percentage (%)
1	Holanda	78,726	36.47
2	EE.UU	74,882	34.69
3	Inglaterra	12,644	5.86
4	Alemania	12,606	5.84
5	Canadá	8,272	3.83
6	Rusia	5,770	2.67
7	Bélgica	5,566	2.58
8	España	5,346	2.48
9	Suiza	3,146	1.46
10	Corea	3,100	1.44
11	Francia	2,282	1.06
12	Otros	3,500	1.62
TOTAL		**215,840**	**100**

Source: *Research team.*

FIGURE 36:

EXPORT VOLUME AND PERCENTAGE TO VARIOUS DESTINATIONS IN PERU. YEAR 2020



There are 14 certified export plants in Peru that process fresh mangos for export, of which 11 are certified for export to the US.

It's important to highlight that, of all the countries that export fresh mangos to the US, Peru is the only one that the USDA delegates the inspection activities to, which is certainly recognition of the good work carried out by SENASA in Peru.

During the period from the year 2016 to the year 2020, a yearly average of 13.2 million 4kg boxes were exported to the US, the equivalent of 52,590 metric tons per year (Refer to Table 25 and Figure 37).

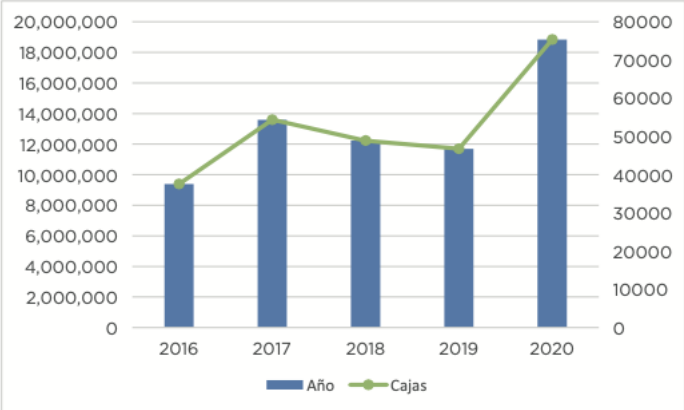
TABLE 25:

MANGO EXPORTS FROM TO THE US

Year	Metric Tons	4kg Boxes
2016	37527	9,381,741
2017	54371.2	13,592,791
2018	48909.7	12,227,413
2019	46785.2	11,696,288
2020	75359.3	18,839,816
TOTAL	**262952**	**65738049**
Average	**52590.4**	**13147609.8**

FIGURE 37:

MANGO EXPORT TO THE US. PERIOD 2016-2020



Source: Research team.

Table 26 and Figure 38 show the share of mango exports for each of the main Peruvian companies.

Sunshine export, Camposol, Asica Farms and Jumar Peru, are the largest companies that export fresh mangos to the US.

TABLE 26:

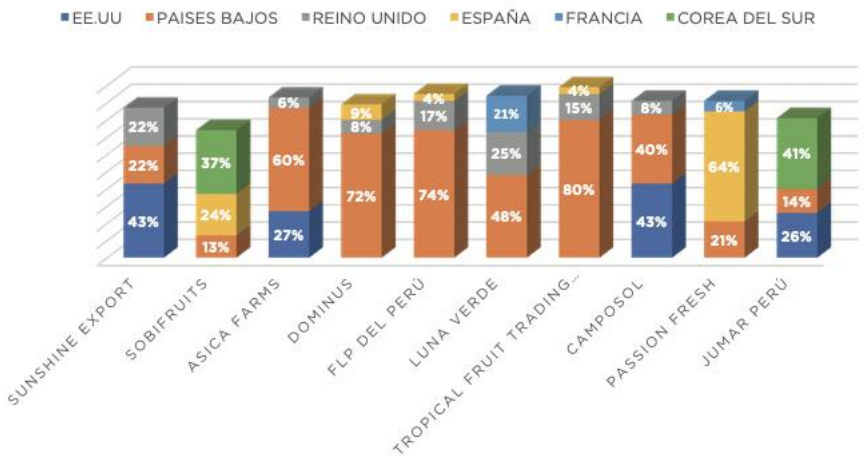
THE 10 LARGEST MANGO PACKING HOUSES/EXPORTERS FROM PERU TO VARIOUS DESTINATIONS, 2021

No.	NAME	US	NETHERLANDS	UNITED KINGDOM	SPAIN	FRANCE	SOUTH KOREA
1	Sunshine Export	43%	22%	22%			
2	Sobifruits		13%		24%		37%
3	Asica Farms	27%	60%	6%			
4	Dominus		72%	8%	9%		
5	FLP del Perú		74%	17%	4%		
6	Luna Verde		48%	25%		21%	
7	Tropical Fruit Trading Perú		80%	15%	4%		
8	Camposol	43%	40%	8%			
9	Passion Fresh		21%		64%	6%	
10	Jumar Perú	26%	14%				41%

Source: *Research team, based on information obtained from* MINAGRI and APEM.

FIGURE 38:

PERCENTAGE OF MANGO EXPORTS FROM PERU TO OTHER DESTINATIONS 2021



Source: *Research team, based on information obtained from* MINAGRI and APEM.

Mango production exports from Peru occur during the period between week 46 and week 8, that is, from the month of November until the month of February.

9.4.4 CURRENT STATUS OF THE FRUIT FLY PROGRAM IN PERU (MOSCAFRUT)

9.4.4.1 Background

Fruit flies (Ceratitis Capitata and Anastrepha spp), are one of the most harmful pests that attack fruit and other crops in Peru.

According to the National Agricultural Health Service (SENASA), the estimated losses caused by fruit fly infestation in Peru constitute at least 30% of the total production of the host crops, and approximately 233,000 fruit farmers in the Peruvian coastal regions are directly affected by the pest.

These fruit farmers have had to implement pest control measures that increase their production costs. In some cases, their access to international markets has been limited by the phytosanitary restrictions imposed on the infested areas.

There is a hypothesis that fruit fly infestation in Peru came from Brazil, asserting that the Mediterranean fly was detected for the first time in Peru in 1956 in a citrus shipment in the region of Huánuco.

Subsequently, its presence was recorded on the coast: Santa Eulalia and in La Molina (Rodríguez, 1998). It was detected in the Ica region two years later, in 1958.

In Peru, the two main genus of fruit fly that cause damage are: Anastrepha and Ceratitis (Rodriguez, et al., 1997), including the following species:

- Ceratitis capitata Wiedemann Mediterranean fruit fly
- Anastrepha fraterculus Wiedemann South American fruit fly.
- Anastrepha striata Schiner Guava fruit fly.
- Anastrepha distincta Greene Pacae fruit fly.
- Anastrepha serpentina Wiedemann Sapodilla fruit fly.
- Anastrepha oblicua Macquart Plum fruit fly.

Figure 39 shows the Geographic distribution of the main fruit flies that are present in Peru.

FIGURE 39:

DISTRIBUTION OF THE MAIN FRUIT FLIES IN PERU.

Source: Sub-directorate of Fruit Fly Control, SENASA, MINAGRI.

Since the fruit fly species is a very severe pest of great economic importance for the fruit production sector, SENASA and MINAGRI deemed it necessary to implement an institutional program for the prevention, detection, control, and eradication of this pest for the purpose of protecting and stimulating the Peruvian agricultural exports sector.

In this regard, since the 1980s, they undertook the development of a fruit fly control and eradication program in the Peruvian territory with the support of the Inter-American Institute for Cooperation on Agriculture (IICA).

Nevertheless, it wasn't until 1998 that they executed a more concrete long-term strategy for the eradication of fruit flies in the entire Republic of Peru, with the support of the International Development Bank (BID).

In 1998, the Agricultural Health Development Program (PRODESA) was the first project implemented for this purpose (through a sovereign guarantee loan of US$45 million), followed by the Fruit Fly Control and Eradication Project (through a sovereign guarantee loan of US$15 million).

Subsequently, in 2009, the bank approved a third sovereign guarantee loan for US$25 million.

This long-term strategy for fruit fly control and eradication in Peru led to the creation of the Sub-directorate of Fruit Fly Control, attached to the National Agricultural Health Secretariat (SENASA) of the Ministry of Agriculture and Irrigation (MINAGRI), that proposed the eradication of the pest in five stages:

Stage I: 1998-2005
Stage II: 2006-2009
Stage III: 2010-2013
Stage IV: 2014-2019
Stage V: 2020-2024

For this purpose, the Sub-directorate of Fruit Fly Control and Phytosanitary Projects set a general objective to "Resolve in a consistent and durable manner the problem posed by fruit flies in Peru," maintaining two basic lines of action:

a) Maintain the national monitoring system

b) Implement control, suppression, and eradication projects

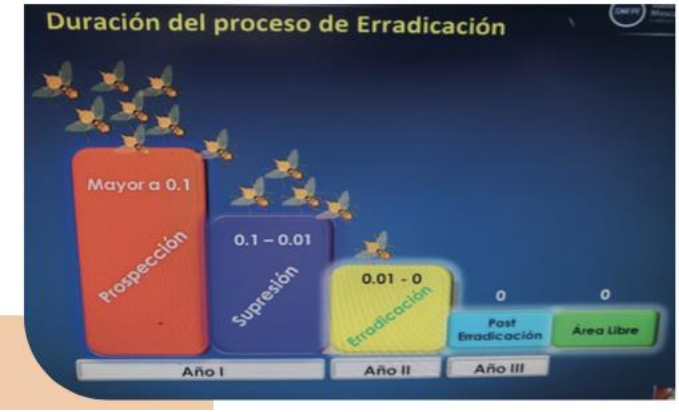
The strategy implemented by SENASA, through the Sub-directorate of Fruit Fly Control, for regulating the pest encompassed five stages of intervention and an approximate timeframe of four years until the objective of obtaining the fruit fly free declaration was met (Refer to Figure 4).

The five stages are:
1) Surveying and monitoring (surveillance).
2) Suppression (collection and burial of fruits that were host to the pest).
3) Eradication (application of toxic bait).
4) Post-eradication (the rate of incidences declines because it is reaching eradication conditions).

5) Prevention.

FIGURE 40:

FRUIT FLY ERADICATION PROCESS STAGES.



Source: Sub-directorate of Fruit Fly Control, SENASA, MINAGRI.

9.4.4.2 Results:

9.4.4.2.1 MOSCA I Project: 1998-2005

The MOSCA I project, had the objective of eradicating a species of fruit fly (Ceratitis capitata) from the departments of Tacna and Moquegua.

In Project I, the eradication strategy was not set up in stages. An investment of US$74,154,863 was made in the project (Tacna, Moquegua, pilot areas, institutional strengthening).

9.4.4.2.2 MOSCA II Project: 2006-2009

This project also had the objective of eradicating a single species of fruit fly (Ceratitis capitata), however, other species of the Anastrepha genus were also eradicated during the execution process.

In this project, the strategy was broken down by stages with pre-defined activities and periods.

For the year 2008 in Arequipa, and 2009 in ICA, the departments were declared fully eradicated from Mediterranean fruit fly, Pacae fruit fly, South American fruit fly, and Sapotaceae (Sapote) fruit fly.

Stage II was carried out with an investment of US$46,660,354 (Arequipa, Ica, Lambayeque)

9.4.4.2.3 MOSCA III Project: 2010-2013

This project was the continuation of the south-north eradication strategy.

The fundamental objective was to recognize Valle de Cañete (Lima) as a fruit fly free area and, likewise, the rest of the Lima provinces during the post-eradication period, including the departments of Ancash, Virú, Pataz, and La Libertad, as well as the inter-andean valleys of Junín, Huánuco and Pasco.

These actions were a part of the Agricultural Health and Produce Safety Development – PRODESA, which was executed by SENASA for the purpose of eradicating fruit flies in the departments of Piura, Tumbes, Lambayeque, La Libertad, Amazonas, Apurímac, Cusco, Puno, and Cajamarca.

Stage III was carried out from 2010 to 2014, at an investment of US$113,558,762 (Lima, Áncash, La Libertad, Ayacucho, Huancavelica, Junín, Huánuco and Pasco).

9.4.4.2.4 MOSCA IV Project: 2014-2019

The National Agricultural Health Service (SENASA) developed Stage IV of the fruit fly eradication project for the 2019-2023 period.

The objective is to declare 103,000 ha located in the regions of Tumbes, Piura, Lambayeque, La Libertad, Cajamarca, Amazonas, Apurímac, Cusco, and Puno as fruit fly free areas.

These actions (which include the operational and quarantine components) involved an investment of $115 million (with support from the IDB through a loan and matching funds contributed by the state) and will benefit 880,000 fruit producers.

Table 27 shows that during the period from 1998–2021 (24 years), Peru has invested a total of US$349.4 million, at an average annual amount of US$14.6 million.

TABLE 27:

INVESTMENTS MADE BY PERU AND THEIR FRUIT FLY ERADICATION PROCESS. PERIOD 1998-2021

STAGE	PERIOD	YEARS	US $ INVESTED	Annual Average US $
I.	1998-2005	8	74,154,863	9269357.9
II.	2006-2009	4	46,660,354	11665089
III.	2010-2013	4	113,558,762	28389691
IV.	2014-2021	8	115,000,000	14375000
TOTAL		**24**	**349,373,979**	**14557249**

During the last stage (IV) of the fruit fly eradication process in Peru, an estimated total investment of US$115 million was made to meet the goal of eradicating 103,000 ha.

This implied a total average investment of $1,116.5/ hectare, the equivalent of US$140/hectare/year.

Figure 41 shows the historical process for the eradication stages carried out in Peru during the 1998-2021 period.

FIGURE 41:

HISTORICAL PROCESS OF THE FRUIT FLY ERADICATION STAGES IN PERU.

Source: Sub-directorate of Fruit Fly Control, SENASA, MINAGRI.

The fruit fly program in Peru is an integrated intervention that includes the following activities:

a) technical assistance for agricultural producers to provide them information regarding specific pest characteristics, as well as training on the best practices for their prevention and control

b) installation of fruit fly traps to monitor the prevalence of the pest

c) application of specific insecticides for fruit flies

d) release of sterile male fruit flies as a control and eradication mechanism

e) implementation of quarantine centers for monitoring, detecting, and restricting access to host crops that are infested in the treated areas

All the activities were implemented exclusively by SENASA technical personnel.

The program was gradually implemented in various stages. During each stage, a specific region was treated on the Peruvian coast. The treated areas are defined based on their geographical continuity and available budget. Once the treatment for a specific zone was completed, the intervention started the implementation in the immediate adjacent area, moving progressively from the south most area along the coast to the north of the country.

9.4.4.3 Current Status

At the national level, SENASA intervenes with monitoring actions in 22 regions. Figure 42 shows the existing trapping network in Peru.

FIGURE 42:

Source: Sub-directorate of Fruit Fly Control, SENASA, MINAGRI.

To date, fruit fly control measures have been undertaken in 13 regions (stages I, II and III), which will benefit 243,000 producers that account for approximately 800,000 ha, of which 52,000 ha are certified as pest free (Tacna and Moquegua), 280,000 ha had the pest eradicated, and the areas under suppression, which are on the order of 465,000 ha.

To these 13 regions, 9 more regions were added as part of the stage IV of the project, where there are already actions and monitoring in place, and where the development of control actions will begin.

Within the framework of the MOSCA IV Project (2019-2023), efforts continue by SENASA to eradicate fruit flies, which include technical assistance, application of organic insecticides, release of sterile male fruit flies to reduce reproduction, and the implementation of quarantine centers for monitoring, detecting, and restricting the movement of infested fruit from treated areas to non-treated areas.

The program has completed three stages between 1998 and 2014 and covered more than 1,000,000 ha of agricultural lands and 150,000 ha of host farms, which are where the fruit flies can feed and reproduce along the coastal region.

Currently, there are 27 control stations operating that are located in Tacna, Moquegua (fruit fly free regions), Arequipa, Ayacucho, Lima, La Libertad and Apurímac.

At the control stations, operators undertake the inspection and control of equipment and vehicles, verify that shipments transporting host fruits for this pest meet transportation conditions and carry the required Domestic Transportation Phytosanitary Certificate, and enforce sanctions for those who are not in compliance with SENASA guidelines.

In this manner, contributions can be made to the fruit fly control process which will generate more opportunities for the domestic and international marketing of various fruit products, improving the quality of life of producers and stakeholders linked to this activity.

The inspection procedures at the control stations, in some cases, are conducted in conjunction with the Peruvian National Police, SUTRAN, SUNAT and the Federal Office of the Attorney General.

In recent months, an intensive awareness effort directed at growers was undertaken by APEM and the Ministry of Agriculture and Irrigation (MINAGRI).

Approximately 1,500 producers from the valleys of Alto Piura and San Lorenzo received training through a series of theoretical/practical workshops on fruit fly integrated management practices.

Trapping is used to better understand the fruit fly species that exist in the area, determine the limits of an area that is infested or free of the pest, and establish the seasonal fluctuations of fruit fly populations.

SENASA has established a fruit fly monitoring network, using different types of traps for this purpose and installing a large number of traps that are strategically located in the entire country.

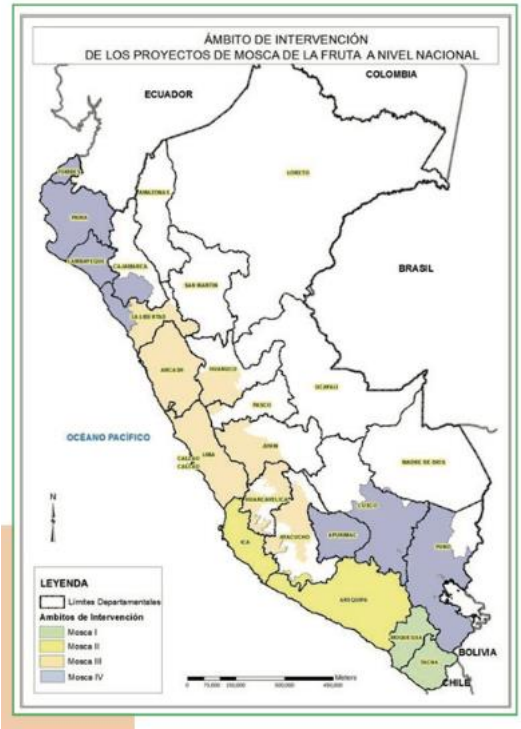
9.4.4.5 Projections

SENASA has set the challenging goal to have zones declared as fruit fly free areas by the year 2023, that is, the eradication of the pest must be completed along the entire Peruvian coast and inter-Andean valleys that have great potential for fruit farming (Refer to Figure 43).

As part of the measures undertaken by the Agricultural Health and Produce Safety Development Program – PRODESA – that is executed by SENASA with the objective of eradicating fruit flies in the departments of Piura, Tumbes, Lambayeque, La Libertad, Amazonas, Apurímac, Cusco, Puno and Cajamarca, the Ministry of Agriculture and Irrigation (MINAGRI) stated that, beginning in the month of July 2021, intensive fruit fly control and suppression measures will begin in the Piura region for the benefit of more than 70,000 small fruit farmers.

FIGURE 43:

MOSCAFRUT PROJECTIONS, PERU.



Source: Sub-directorate of Fruit Fly Control, SENASA.

The actions will be led by the National Agricultural Health Service – SENASA, as the strategic branch of MINAGRI.

The projection is to service 60,917 ha of fruit farming operations in the department of Piura, located in the provinces of Piura, Sechura, Paita, Sullana, Morropón, Huancabamba and Ayabaca.

As in prior activities, technical personnel will collect the field data related to the distribution of the various types of traps to be installed, evaluation routes, weekly follow-up of captures, main crop areas, etc.

All this information is necessary to start the suppression and control actions beginning in the month of July 2021, considering the historic FTD as a strategy due to the reduction in the population of the pest that tends to appear during the months of May to October.

The trapping network installed in the Piura region exceeds 9,000 traps, which are monitored daily by SENASA's technical personnel.

The National Agricultural Health Service (SENASA) will implement 18 control stations this year on national soil as part of the fruit fly control strategy in nine regions of Peru. With the health actions

developed by the control stations and executed by farmers, pest control costs and production losses will be avoided in the fruit farming areas contained in the regulated areas.

The control stations have the objective of protecting the regulated areas located in the regions of Tumbes, Piura, Cajamarca, Amazonas, Apurímac, Cusco and Puno from the incursion and reinfestation of fruit flies in the fruit production zones of our country, as well as the thousands of growers that make up the family agriculture community.

The Fruit Fly Eradication Project led by SENASA focuses on the department of Piura and has begun to establish strategic partnerships with the Regional Government of Piura, and local governments, that have capitalized on the opportunity to integrate efforts for the benefit of the fruit farmers operating in the northern region of the country.

SENASA will continue to carry out monitoring operations in 60,917 ha of fruit production areas located in the provinces of Piura, Sechura, Paita, Sullana, Morropón, Huancabamba and Ayabaca.

It will also develop training for specialists that work for the municipalities, as well as producers in the intervention areas, to educate them on the integrated control practices that must be conducted in a timely way to ensure the eradication of the pest on their farms.

To date, SENASA in Piura has signed letters of commitment in its 10 production zones with the district municipalities of Santo Domingo, Santa Catalina de Mosca, San Juan de Bigote, La Unión, Querecotillo, Marca- velica, Canchaque, Lalaquiz, Huancabamba, Montero, Paimas and Ayabaca, as well as agricultural product commercial exporters.

A preliminary agreement was made regarding SENASA's session on product storage spaces that will be used during the control and suppression stage, as well as for the implementation of microcenters, among others.

The Regional Department of Agriculture of Piura (DRAP) also agreed to join as a partner, considering the integrated solution to this objective to be of great importance, "Fruit fly eradication will allow our fruits to be marketed in different markets without restriction, by being pest-free. Additionally, it will permit growers to increase their income and improve the quality of their supply".

9. BRAZIL

9.5.1 MANGO PRODUCTION AREAS CURRENTLY IN BRAZIL

According to the information provided by VALEXPORT, during the 2018-2020 harvest seasons, there was a total average mango production area of 69,415 ha in Brazilian territory, but by the year 2020 there were a reported 74,529 ha of mango production area (Refer to Table No. 28 and Figure 44)

TABLE 28:

MANGO PRODUCTION AREAS. PERIOD 2018-2020, BRAZIL

No.	SEASON	Hectares
1	2018	65,963
2	2019	67,754
3	2020	74,529
TOTAL		**208,246**
AVERAGE		**69415.33333**

FIGURE 44:

PERCENTAGE OF ANNUAL PRODUCTION

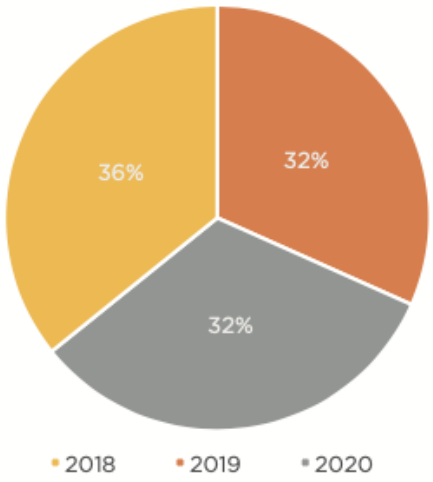


Table 29 and Figure 45 show the distribution broken down by region for mango production areas in Brazilian territory, in which 90% of Brazilian mangos are grown in the northeast and southeast regions.

The main mango producing States are: Sao Paulo (23%), Bahía (22%), Pernambuco (11%), Minas Gerais (11%) and Paraíba (7%).

Mangos are produced in every region in Brazil, predominantly the southeast and northeast. Due to the excellent conditions for development, the northeast stands out for supplying 49% of the national production.

TABLE 29:

MANGO PRODUCTION AREAS. PERIOD 2018-2020, BRAZIL

No.	REGION	Hectares
1	North	2,572
2	Northeast	36,573
3	Midwest	2,686
4	South	1,700
5	Southeast	30,998
TOTAL		**74,529**

FIGURE 45:

DISTRIBUTION OF MANGO PRODUCTION AREAS (HECTARES) IN BRAZIL

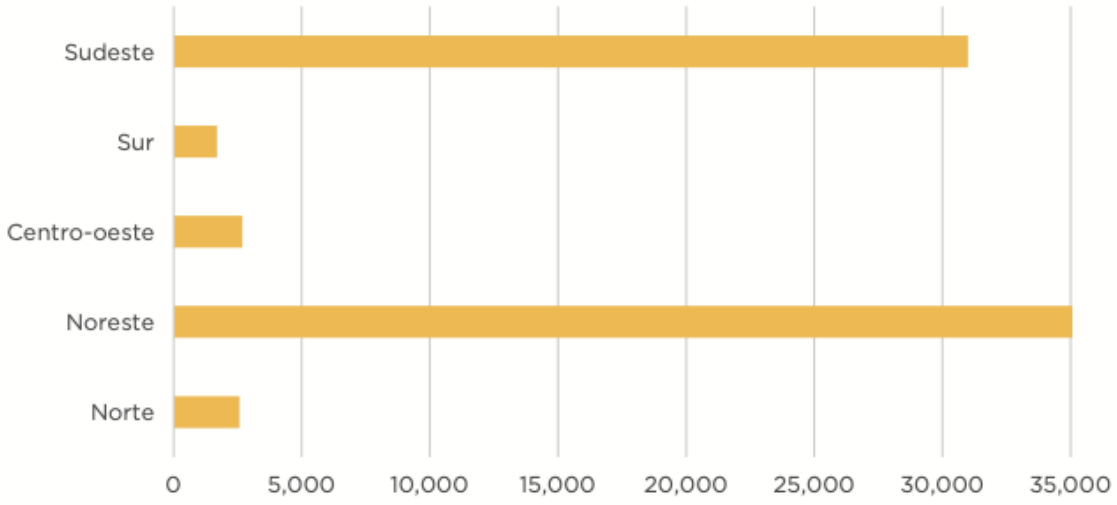


Figure 46 shows the different States that make up one of the regions in Brazil.

FIGURE 46:

STATES THAT MAKE UP THE DIFFERENT REGIONS IN BRAZIL

The largest amount of mangos that are exported to the US, as well as other destinations, comes from the northeast region of the country, with the States of Bahía and Pernambuco having the largest percentage share. (Refer to Table No. 30 and Figure 47).

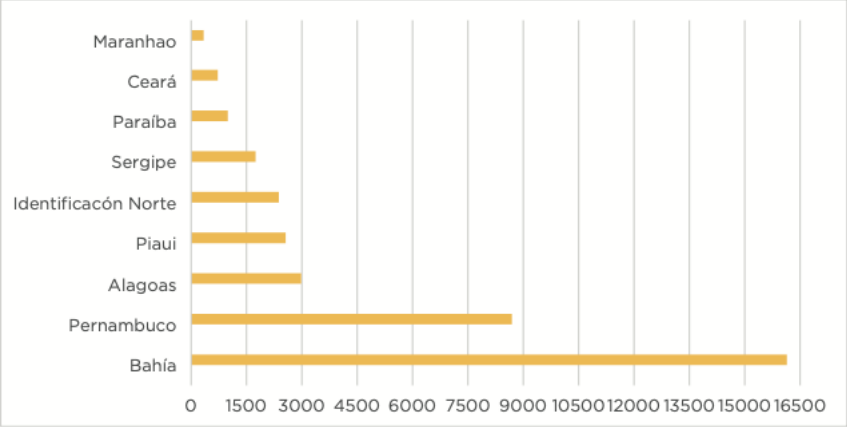
TABLE 30:

MANGO PRODUCTION AREAS. PERIOD 2018-2020, BRAZIL

No.	STATE	Hectares	Accumulated (%)
1	Bahía	16,140	
2	Pernambuco	8,690	67.9
3	Alagoas	2,981	
4	Piaui	2,565	
5	Identificacón Norte	2,376	
6	Sergipe	1,751	
7	Paraíba	998	
8	Ceará	727	
9	Maranhao	345	
TOTAL		**36,573**	

FIGURE 47:

MANGO PRODUCTION AREAS IN THE NORTHWEST REGION, BRAZIL



Source: *Research team, based on data obtained from* COMEXTAT.

Just the Valle de San Francisco, a region with a predominantly semi-arid climate, is estimated to have a mango production area of 40,000 ha, of which the Petrolina-Juazeiro corridor has approximately 25,000 ha.

9.5.2 LOCATION OF MANGO PRODUCTION AREAS THAT CURRENTLY EXPORT FRESH MANGOS TO THE US

According to information provided by VALEXPORT, currently (year 2020), Brazil has 12,161 ha of mango production with export quality registered.

This implies that in Brazil, of the total area planted with mangos (74,529 ha), 12,161 ha (16%) are reserved for exports to various destinations, and only 2,421 ha (3.2% of the total area planted, and 19.9% of the export areas) are set aside for the production, harvest, and processing of fresh mangos for export to the US.

From 2018-2020, Brazil exported to the US a yearly average of 11.7 million 4kg boxes of fresh mangos, the equivalent of 48,423 metric tons per year.

The main mango production areas for export to the US are located in the States of Bahía and Pernambuco.

9.5.3 MANGO EXPORT VOLUMES IN BRAZIL

According to the information provided by IBGE, during the 2018-2020 export seasons, the republic of Brazil dedicated an area of 10,492 ha to the production and export of mangos to various markets, of which only 1,976 hectares were reserved for the US market. In the year 2020, mangos were grown on 2,421 ha that exported mangos to the US (Refer to Table 31).

TABLE 31:

MANGO PRODUCTION AREAS FOR EXPORT TO THE US AND OTHER DESTINATIONS. PERIOD 2018-2020, BRAZIL

No.	TEMPORADA	Hectáreas (Total)	Hectáreas EE.UU
1	2018	8,523	1,600
2	2019	10,792	1,906
3	2020	12,161	2,421
TOTAL		**31,476**	**5,927**
PROMEDIO		**10492**	**1975.67**

For the 2020 season, of the 12,161 ha that were harvested, a total of 243,224 metric tons were exported to various destinations, of which 48,423 metric tons (20%) were exported to the US from 2,421 ha (20%). (Refer to Table No. 32, Figure 48 and Figure 49)

TABLE 32:

TOTAL EXPORTS OF MANGOS/METRIC TONS. BRAZIL 2020

No.	COUNTRY	AMOUNT	%
1	Holland	109,147	44.8751
2	United States	48,423	19.9088
3	Spain	38,982	16.0272
4	England	16,711	6.87062
5	Canada	8,197	3.37014
6	Portugal	7,902	3.24886
7	Russia	4,674	1.92169
8	Argentina	2,048	0.84202
9	Chile	1,680	0.69072
10	Germany	1,565	0.64344
11	France	1,103	0.45349
12	Arab Emirates	261	0.10731
13	Italy	220	0.09045
14	Other Destinations	2,311	0.95015
TOTAL		**243,224**	**100**

Source: *Research team, based on data obtained from* COMEXTAT.

FIGURE 48:

AMOUNT OF METRIC TONS OF MANGOS EXPORTED FROM BRAZIL TO VARIOUS DESTINATIONS

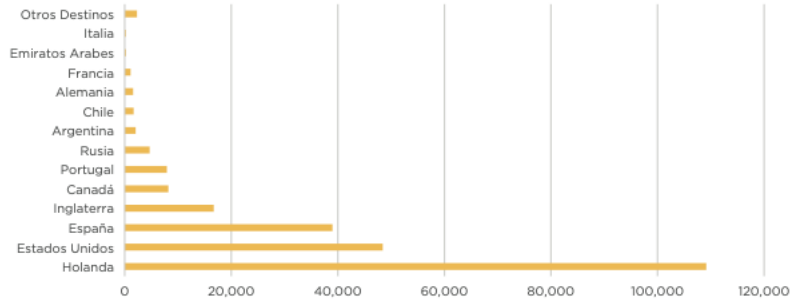
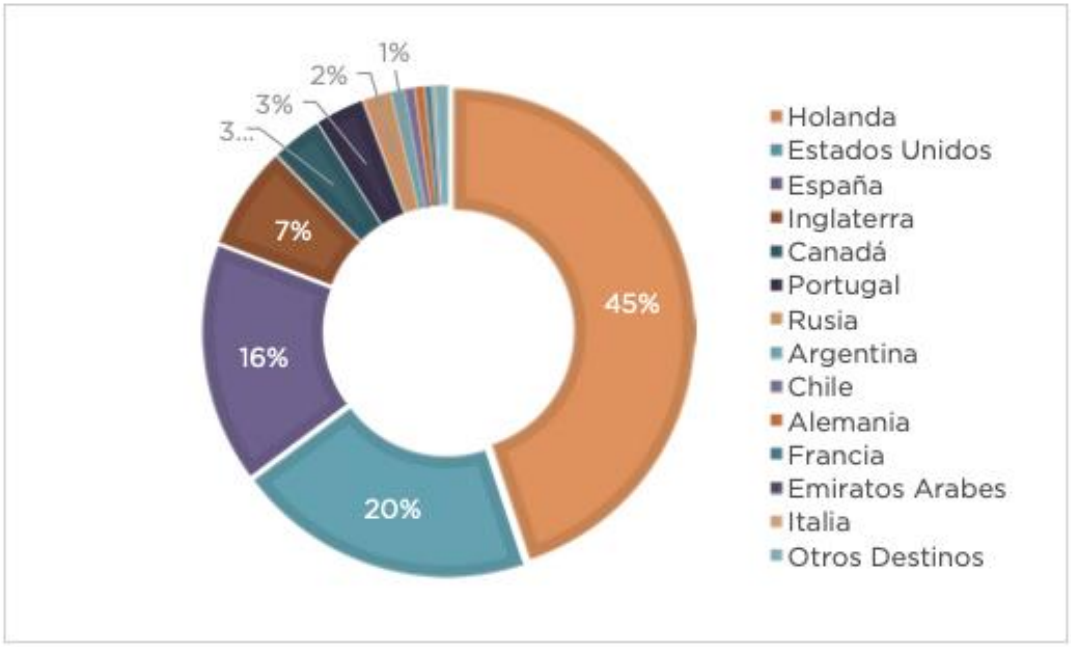


FIGURE 49:

PERCENTAGE OF MANGO EXPORTS FROM BRAZIL TO VARIOUS DESTINATIONS



Source: *Research team, based on data obtained from* COMEXTAT.

In Brazil, there are a total of 10 packinghouses that process fresh mangos for export to the US, of which

Table No. 33, Figures 50 and 51 show percentage share of each packinghouse in the exports to the US.

TABLE 33:

MANGO EXPORTS IN 4KG BOXES FROM BRAZIL TO THE US

No.	NAME	AMOUNT	%
1	IBACEM	2,063,102	17.5744
2	AGROBRAS	1,982,396	16.8869
3	UPA AGRICOLA	1,673,795	14.2581
4	EBRAZ	1,391,480	11.8532
5	SPECIAL FRUIT	1,213,975	10.3412
6	FINOBRASA	1,164,684	9.92127
7	GRAND VALLE	719,541	6.12936
8	ARGOFRUTA	578,958	4.93181
9	AM EXPORT	536,928	4.57378
10	AGRONOGUEIRA	414,400	3.53004
TOTAL		**11,739,259**	**100**

FIGURE 50:

AMOUNT OF 4KG BOXES OF MANGOS EXPORTED FROM BRAZIL TO THE US

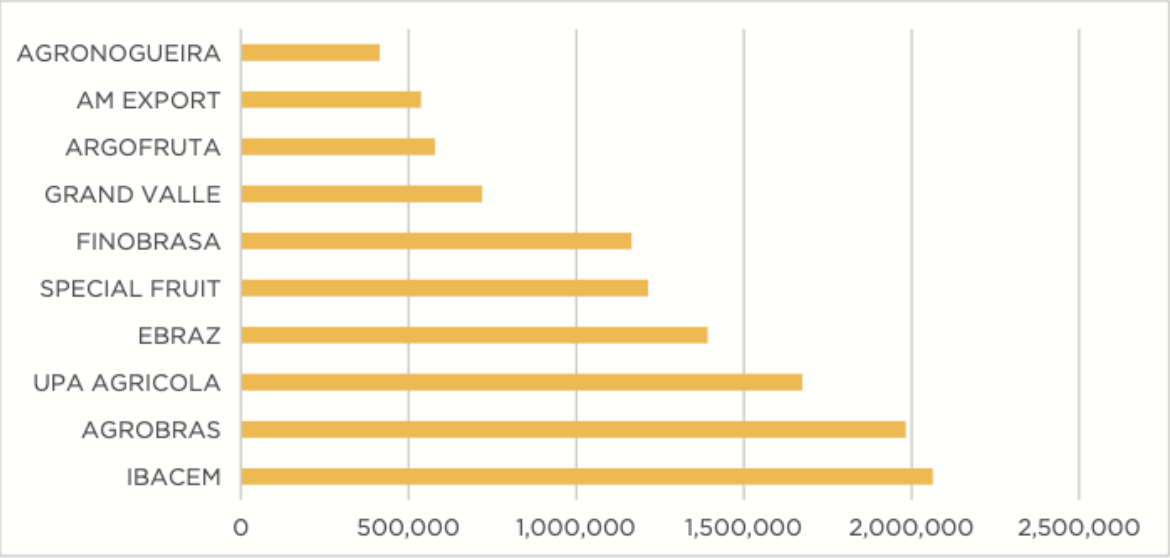
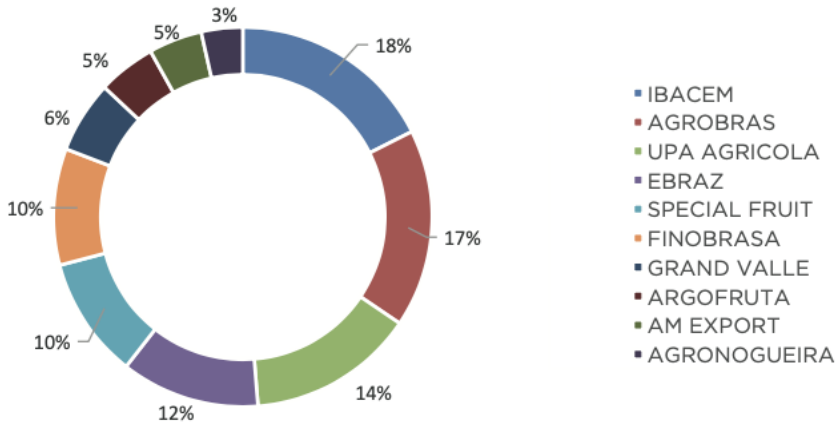


FIGURE 51:

PERCENTAGE OF 4KG BOXES OF MANGOS EXPORTED FROM BRAZIL TO THE US



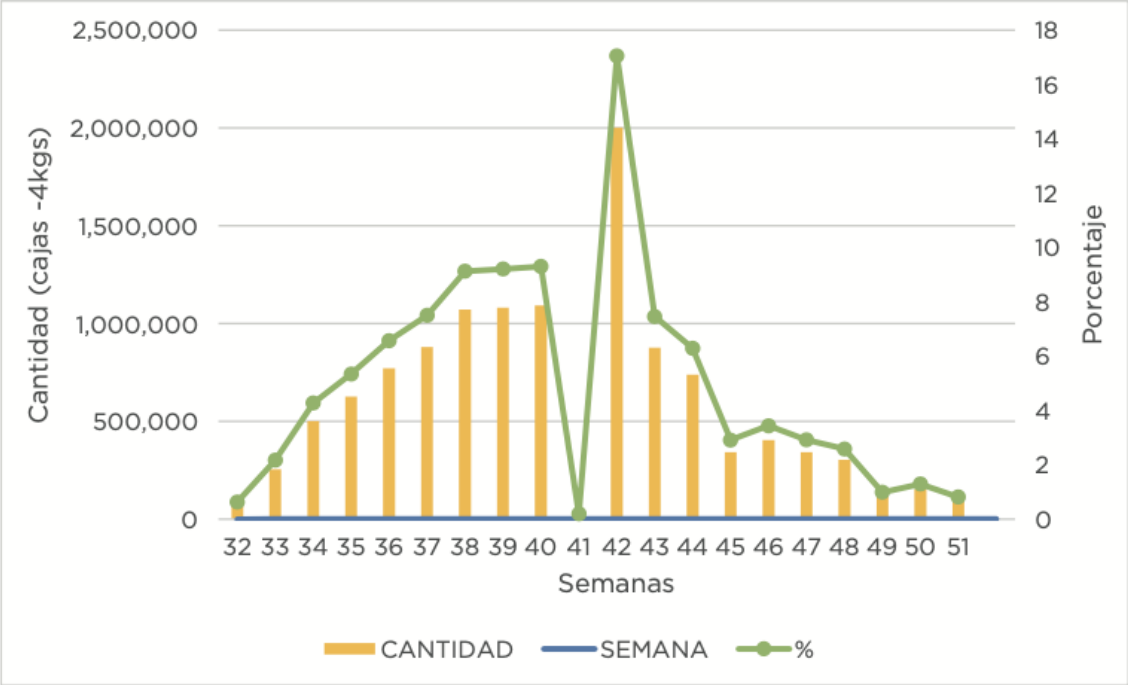
Mango production and exports to the US from Brazil start on week 32 and end on week 51, from the months of September to December.

Table No. 34 and Figure 52 show the weekly behavior of mango exports from Brazil to the US market.

TABLE 33:

SEMANA No.	**CANTIDAD** Cajas de 4 kgs	**%**
32	73,808	0.62873
33	254,546	2.16833
34	501,214	4.26955
35	626,655	5.33811
36	771,109	6.56863
37	879,774	7.49429
38	1,070,445	9.1185
39	1,080,124	9.20095
40	1,091,698	9.29955
41	22,456	0.19129
42	2,001,674	17.0511
43	875,216	7.45546
44	738,363	6.28969
45	341,663	2.91043
46	403,171	3.43438
47	342,125	2.91437
48	302,944	2.58061
49	115,752	0.98602
50	151,267	1.28856
51	95,256	0.81143
TOTAL:	**11,739,260**	**100**

FIGURE 52:



Source: *Research team, based on data obtained from* USDA/APHIS.

9.5.5 CURRENT STATUS OF THE FRUIT FLY PROGRAM IN BRAZIL (MOSCAFRUT).

The Mediterranean fruit fly (Ceratitis capitata) was detected for the first time in Brazil in 1901, and subsequently spread throughout the entire country and the rest of the American continent.

Another fruit fly that is present in Brazil is the Carambola (Bactrocera carambolae) fruit fly, which is a quarantine pest that was detected in Brazil in 1995, in the States of Amapá, Pará and Roraima, which are located far from the Brazilian fruit production centers.

The main species of Anastrepha that exist in Brazilian fruit production centers are: Anastrepha obliqua, Anastrepha fraterculus and Anastrepha grandis.

In 2015, the Ministry of Agriculture, Livestock, and Supply (MAPA) established the National Fruit Fly Program (PNMF), attaching greater emphasis to the Mediterranean fruit fly, as well as the fruit flies of the Anastrepha genus, including the following species: fraterculus, oblicua, grandis, and the Carambola fruit fly: Bactrocera carambolae, a species restricted to the States of Amapá, Pará and Roraima.

FIGURE 20:

NATIONAL FRUIT FLY PROGRAM LAUNCH.

Source: National Fruit Fly Program*, Brazil, 2015*

The National Fruit Fly Program – PNMF – is created as part of the Ministry of Agriculture, Livestock, and Supply (MAPA).

The MAPA established goals that included suppressing the Mediterranean fruit fly population, recognizing the region located above the 13th parallel as an Anastrepha grandis fruit fly free area, and controlling fruit flies in the Valle de San Francisco.

Nevertheless, the PNMF specifically established the objective of developing phytosanitary policies for the prevention, control, and eradication of fruit flies of economic and quarantine importance for Brazil and for the Brazilian fruits import market.

To that end, MAPA, Plant Health, and PNMF are planning for the possibility of eradicating fruit flies of economic and quarantine importance, and eventually establish areas that are free of these pests.

The PNMF, is made up of four sub-programs:

1. Bactrocera carambolae;
2. Anastrepha spp;
3. Ceratitis capitata;
4. Other fruit flies of economic in quarantine importance.

The Anastrepha spp sub program will include the species: Anastrepha grandis, A. fraterculus, and A. obliqua.

PNMF actions will be implemented on a priority basis in the municipalities that have already received official recognition as Pest Free Areas, Low Prevalence Areas, or Integrated Measures Areas as part of the Risk Management System strategy.

Coverage will also be provided for municipalities where the implementation of prevention, control, and eradication actions for quarantine pests is deemed unnecessary at the discretion of the Secretariat of Agricultural Defense.

In 2011, the municipalities of Belén de San Francisco, Petrolina and Santa María de Buena Vista, from the state of Pernambuco, implemented the risk management system for pests in an effort to control the fruit fly in mango farming operations (refer to Figure 52)

According to information from MAPA, Brazil will invest $34 million in the effort against one of the most relevant pests in Brazilian fruit farming, fruit flies, that cause economic damage on the order of US$120 million a year between production losses and control, processing, and marketing costs.

The objective of the program is to establish international controls on pest monitoring policies in Guyana, French Guyana, Suriname, Venezuela, and Trinidad and Tobago, in addition to the inclusion of permanent surveillance systems in ports of entry and airports located in unaffected regions for the purposes of preventing dispersion.

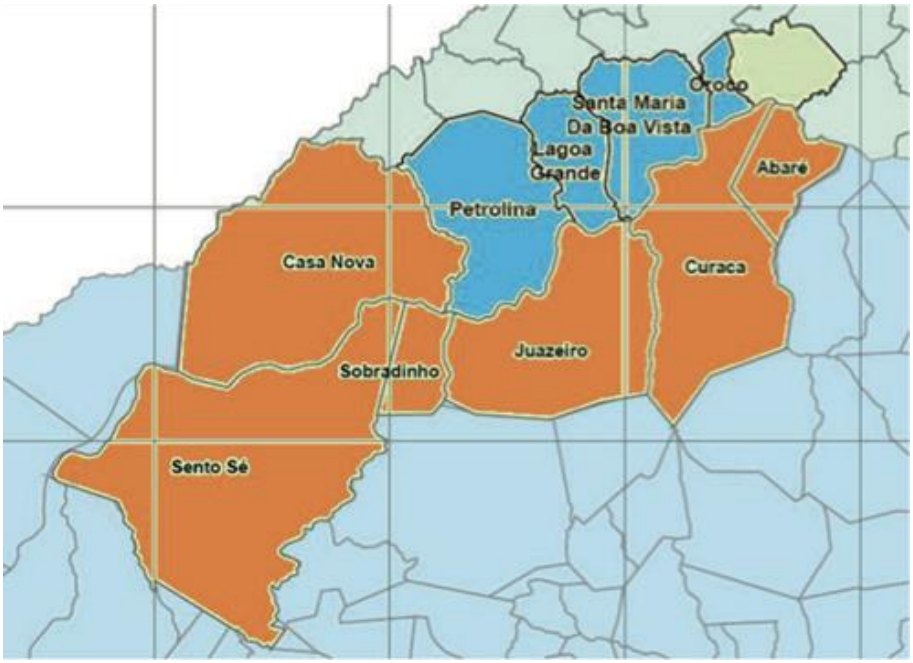
As indicated, in some regions of Brazil it is also possible to find the Carambola fruit fly (Bactrocera carambolae) during the eradication process that, in addition to affecting this fruit, also affects 50 other fruits.

The investment program will cover the implementation of risk mitigation systems, as well as certification and eradication programs. Additionally, US$1.5 million will be directed to the sub program each year to eliminate the Carambola fruit fly.

In 2011, the municipalities of Belén de San Francisco, Petrolina and Santa María de Buena Vista, from the state of Pernambuco, implemented the risk management system for pests in an effort to control the fruit fly in mango farming operations (refer to Figure 53)

FIGURE 53:

RISK MANAGEMENT SYSTEMS FOR MANGO FRUIT FLIES



Source: *National Fruit Fly Program*

Brazil has the appropriate organization for the detection, control, eradication, and establishment of fruit fly free areas and, to date, can highlight the following achievements:

a) Eradication of Bactrocera carambolae in the States Amapá, Pará and Roraima.

b) Suppression of Ceratitis capitata in Valle de San Francisco in the States of Pernambuco and Bahía.

c) Risk management system in the production and export of papaya for the Ceratitis capitata and Anastrepha fraterculus pests in the States of Espíritu Santo and Río Grande Do Norte.

d) Risk management system in the production and export of cucurbitaceous for the Anastrepha grandis pest in the States of Bahía, Golás, Minas Gerais, Sao Pablo, Paraná and Río Grande du Sul.

e) Risk management system in the production and export of mango for the Ceratitis capitata and Anastrepha spp. in the state of Pernambuco and Bahía.

f) In the States of Bahía and Río Grande Do Sul facilities have been built for the production of sterile male fruit flies to support the autocidal control strategy.

Figure 54 shows the various advances made with regard to fruit flies in Brazil.

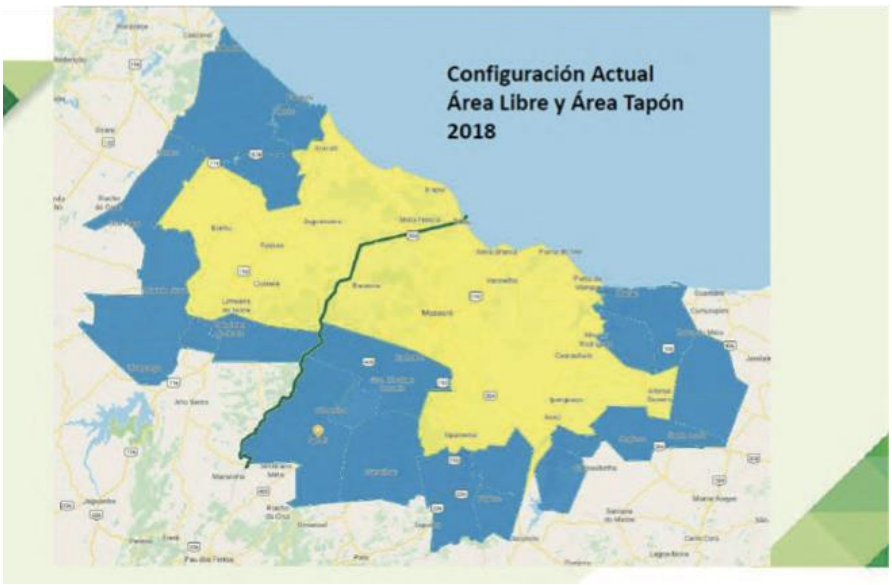
FIGURE 54:

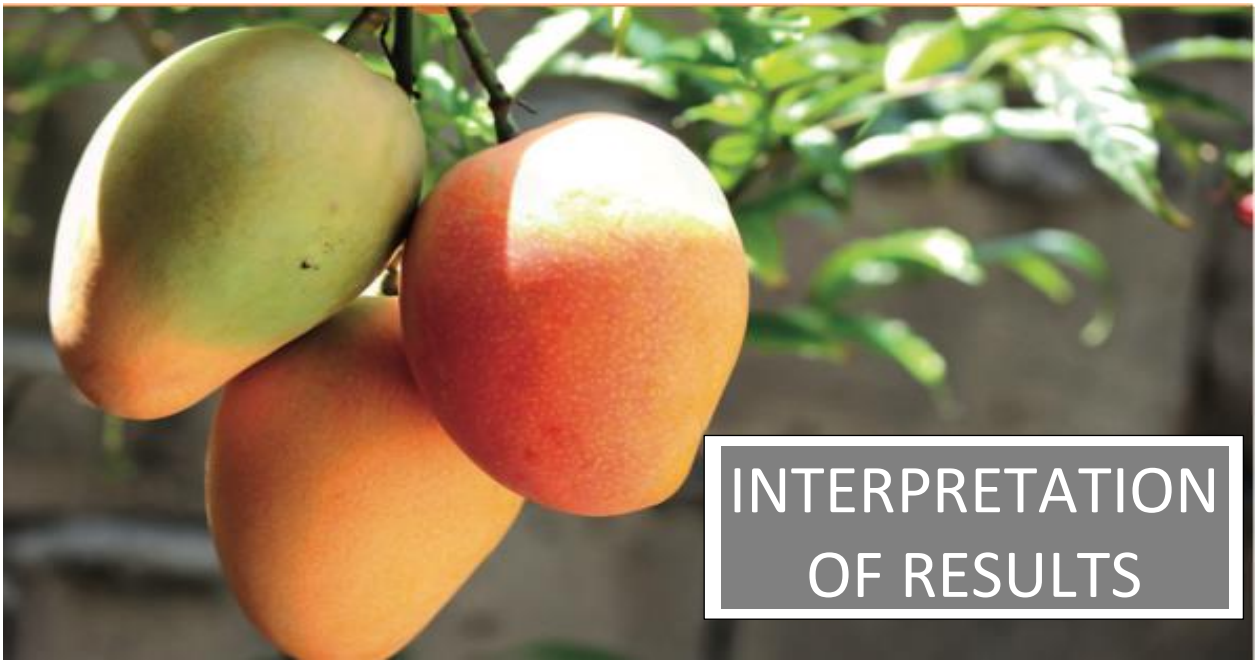
ADVANCES MADE IN BRAZIL IN FRUIT FLY CONTROL AND ERADICATION

Source: *Obtained from* Regina Sugayama (Status of fruit flies in Brazil, 2016).

g) The States of Ceará (7 municipalities) and Rio Grande do Norte (13 municipalities) now have 20 municipalities that have been recognized as fruit fly free areas (Anastrepha grandis), after verification by the Ministry of Agriculture, Livestock, and Supply (MAPA) of the expansion of the Pest Free Area (ALP). Refer to Figure No. 55.

FIGURE 55:





After conducting a survey of the mango production areas in the countries of Mexico, Guatemala, Ecuador, Peru, and Brazil, with an emphasis on mango production areas that are currently exporting to the US and correlating the phytosanitary status of the fruit fly control results, we can observe the following:

10.1 Mexico:

208,000 ha of mango production areas are Mediterranean fruit fly free.

In the north to south strategy implemented by Mexico to control and eradicate fruit flies, of the 31,806 ha of mango farms in the state of Sinaloa, 6,240 ha are internationally recognized by the USDA as fruit fly free areas and, the remaining 25,566 ha have been officially declared as fruit fly low prevalence areas.

The six municipalities located in southern Sinaloa are the locations with the greatest potential for the establishment of fruit fly free areas.

Tables 34 and 35 show more detailed information.

TABLE 34:

No.	LOCATIONS (States, Provinces, Departments, Municipalities, Cantons).	AREA STATUS	TOTAL AREA (Has)	CURRENT MANGO AREAS (Has)	Recognition by the US (USDA)	Official National Declaration Year (Ministries of Agriculture).	
1	State of Sinaloa (12 municipios)	Free	4,198,500	6,240	a) Ceratitis capitata b) Anastrepha ludens c) Anasatrepha oblicua d) Anastrepha striata e) Anastrepha serpentina		2003
	State of Sinaloa (6 municipios)	Free Baja Prevalence	1,626,500	25,566	Ceratitis capitata	A. ludens A. oblicua A. striata A. serpentina	
	Subtotal		**5,825,000**	**31,806**			
2	Nayarit	Free	2,785,650	25,131	Ceratitis capitata		1982
3	Colima	Free	5,627	5,404			
4	Jalisco	Free	7,859,590	9,264			
5	Michoacan	Free	5,859,870	25,017			
6	Guerrero	Free	6,359,590	24,847			
7	Oaxaca	Free	9,375,760	16,881			
8	Veracruz	Free	7,182,350	18,424			
9	Campeche	Free	5,758,490	4,632			
10	Chiapas	Free	7,331,100	30,814			
	Subtotal		**52,518,027**	**160,414**			
	TOTAL		**58,343,027**	**192,220**			

Source: Research team.

TABLE 35:

No.	LUGARES (Estados, Provincias, Departamentos, Municipios, Cantones).	ESTATUS DEL AREA	AREA TOTAL (Has)	AREAS ACTUAL MANGO (Has)	Reconocimento EE.UU (USDA)	Declaratoria Oficial Nacional. (Ministerios de Agricultura).	Año
11	Baja California	Libre	7,145,000	0	Ceratitis capitata		1985
12	baja California Sur	Lbre	7,390,940	1,681			1995
13	Chihuahua	Libre	24,741,260	0			1998
14	Sonora	Libre	17,935,470	136			2001
15	Coahuila	Libre	15,159,480	0			2004
16	Durango (32 municipios)	Libre	12,336,400	400			2006
17	Nuevo León (19 municipios)	Libre	6,415,620	0			2007
18	Zacatecas (36 municipios)	Libre	7,527,530	28			2008
19	San Luis Potosí (21 municipi	Libre	6,113,800	55			2009
Subtotal			**104,765,500**	**2,300**			
20	Puebla		3,430,960	54	Ceratitis capitata		1982
21	Queretaro		1,169,060	77			
22	Morelos		487,890	337			
23	México		149,430	370			
24	Hidalgo		2,082,140	83			
25	Tamaulipas		8,024,930	858			
26	Tabasco		2,473,000	194			
27	Yucatán		3,952,440	152			
Subtotal			**21,769,850**	**2,125**			
TOTAL			**126,535,350**	**4,425**			

10.2 Guatemala

The Pacific coast States, specifically, Retalhuleu and Suchitepéquez, are where the largest mango production areas are located, and it is these departments that the government has officially declared Mediterranean fruit fly free.

Nevertheless, the departments of Progreso and Zacapa, are production areas that grow excellent quality mangos, and where there is potential for the fruit fly free areas declaration.

In total, a potential 5,000 ha of mango production have been identified for the possible establishment of fruit fly free areas. Refer to Table 36.

TABLE 36:

No.	LOCATIONS (States, Provinces, Departments, Municipalities, Cantons).	AREA STATUS	TOTAL AREA (Has)	CURRENT MANGO AREAS (Has)	Recognition by the US (USDA)	Official National Declaration (Ministries of Agriculture).	Year
1	Departamento Petén (12 municipios)	Free	2,950,000	114	Ceratitis capitata		1994
2	Departments of Retalhuleu, San Marcos, Suchitepequez, and Quetzaltenango. (10 municipios)	Free	107,360	9,037		Ceratitis capitata	2013
3	Departamento Huehuetenango, las Huistas. (10 municipios).	Free	228,700	60		Ceratitis capitata	2011
4	Departamentos Totonicapan, Quetzaltenango and Solola. (25 municipios).	Free	71,000	0		Ceratitis capitata	2011
						Anastrepha sp.	
						Dacus sp.	
						Bactrocera sp.	
TOTAL			**3,357,060**	**9,211**			

Source: Research team.

10.3 Ecuador

In the Province of Guayas, specifically the Cantons of Empalme, Palestina, and the Parishes of Chongón and El Consuelo, is where there are 5,000 ha of mango production that have low fruit fly prevalence.

Table 37 shows the areas for the provinces of Guayas and Los Ríos where fruit fly free areas can be established.

TABLE 37:

No.	LOCATIONS (States, Provinces, Departments, Municipalities, Cantons).	AREA STATUS	TOTAL AREA (Has)	CURRENT MANGO AREAS (Has)	Recognition by the US (USDA)	Official National Declaration (Ministries of Agriculture).	Year
	4.1 Cantón Mejía	Low Prevalence	141,100	0		Ceratitis capitata	2013
	4.2 Province of Santa Elena	Free	400,300	0		Anastrepha grandis	2015
	4.3 Province of Guayas						
	Cantones: Empalme, Palestina ,						
	Guayaquil.	Free	1,680,300	4,000		Anastrepha grandis	2015
	Parroquias:						
	El Chongon and El Consuelo.						
	4.4 Province of Cotopaxi						
	Cantons: Latacunga, Salcedo and	Free	125,285	0		Ceratitis capitata	2015
	Pujilí						
	4.5 Province of los Ríos						
	Cantons: Quevedo, Buena fé,	Low Prevalence	186,377	500		Ceratitis capitata	2016
	Valencia						
	4.6 Province of Morona	Frees	59,328	0		Ceratitis capitata	2016
	Santiago (Cantón Palora).						
	4.7 Province of Tungurahua	Free	199,200	0		Ceratitis capitata	2016
	Cantons: Ambato, Tisaleo,Mocha,	Low Prevalence				Anastrepha fraterculus	2016
	Cevallos, Píllaro, Pelileo and Quero.						
TOTAL			**2,791,890**	**4500**			

Source: Research team.

10.4 Peru

The Piura and Lambayeque areas have approximately 25,000 ha of mango production that have been declared low fruit fly prevalence zones, and where there is the greatest potential for the establishment of fruit fly free areas.

Table 38 shows the areas with the greatest potential in more detail.

TABLE 38:

No.	LOCATIONS (States, Provinces, Departments, Municipalities, Cantons).	AREA STATUS	TOTAL AREA (Has)	CURRENT MANGO AREAS (HAS)	Recognition by the US (USDA)	Official National Declaration (Ministries of Agriculture).	Year
1	3.1 Tacna	Free	52,000	0	a) Ceratitis capitata		2007
2	3.2 Moquegua			10	b) Anastrepha fraterculus		
3	3.3 Arequipa	Free		12		a) Ceratitis capitata	2008 2009
	3.4 Lima			792		b) Anastrepha fraterculus	
4	3.5 Ica			722		c) Anastrepha serpentina	
5						d) Anastrepha distincta	
6 7 8 9	3.5 Tumbes	Baja	103,000	82		a) Ceratitis capitata	
	3.6 Piura			21,282		b) Anastrepha fraterculus	
	3.7 Lambayeque			4,549		c) Anastrepha serpentina	
	3.8 La Libertad			282		d) Anastrepha distincta	
10 11 12 13	3.9 Cajamarca			1,251			
	3.10 Amazonas			119			
	3.11 Apurimac			79			
	3.12 Cuzco			198			
TOTAL			**155,000**	**29378**			

. *10.5 Brazil*

After researching the mango production areas in Brazil, emphasizing mango production areas that currently export to the US, and correlating them with the fruit fly phytosanitary status results, we can observe that the highest coincidence occurs in the Valle de San Francisco in the States of Pernambuco and Bahia. (Refer to Figure 56)

FIGURE 56:

VALLE DE SAN FRANCISCO, MANGO PRODUCTION AREA WITH POTENTIAL FOR THE ESTABLISHMENT OF A FRUIT FLY FREE AREA

Source: National Fruit Fly Program

TABLE 39:

No.	LUGARES (Estados, Provincias, Departamentos, Municipios, Cantones).	ESTATUS DEL AREA	AREA TOTAL (Has)	AREAS ACTUALES DE MANGO (Has)	Reconocimento EE.UU (USDA)	Declaratoria Oficial Nacional. (Ministerios de Agricultura).	Año
1	Ceará (7 municipios) Icaupí, Acaratí, Itaicaba, Jaguaruana, quixere, Russas, Limoneiro do norte.	Libre	567,600	427	Anastrepha grandis		2008
2	Río Grande do Norte (20 Municipios) Mossoro, Tibau, grossos, Areia branca, Assu, Serra do mel, Baraúna, Alfonzo bezarra, alto rodriguez, Ipanguazu, Apodi, Porto do mangue, Gobernador dix sept rosado, felipe guerra, caraubais, macao, pendencias, jandaira, pedro avelino	Libre	634,600	1,376	Anastrepha grandis		2008
	TOTAL		**1,202,200**	**1,803**			

11. 1 GENERAL

11.1.1 All five countries in the study possess the appropriate institutional framework for the detection, control, and eradication of fruit flies.

Nevertheless, the MOSCAFRUT program in Guatemala needs to be extended with the expiration in December 2021 of the ministerial agreement that served as its legal authority. Subsequently, it should be appropriately strengthened from a technical and financial perspective.

11.1.2 After researching the mango production areas that export to the US, with the fruit fly control and eradication phytosanitary status, 90,000 ha were identified in the five countries that have great potential for the establishment, declaration, and recognition as fruit fly free areas.

Table 40 and Figure 57 show the location of the areas as well as their size for each one of the countries in the study.

TABLE 40:

No.	COUNTRY	LOCATIONS: States, Departments, Provinces, Municipalities, Cantons	POTENTIAL AREA MANGO (Ha)
1	MEXICO	**1°. STATE OF SINALOA**	25,000
		Municipalities:	
		Cosala, San Ignacio, Mazatlán, Concordia,	
		Rosario, Escuinapa.	
2	GUATEMALA	**1° DEPARTMENTS OF RETALHULEU Y**	4,000
		SUCHITEPEQUEZ	
		Municipalities:	
		Retalhuleu, Champerico and la Máquina	
		2° DEPARTMENT DEL PROGRESO Y	1,000
		ZACAPA.	
		Municipalities:	
		El jícaro, Huite, Río Hondo, Estanzuela.	
		Subtotal	**5,000**
3	ECUADOR	**1° PROVINCE OF GUAYAS**	5,000
		Parroquias and Cantons:	
		El Chongón, el consuelo, El Empalme, and	
		Palestina.	
4	PERU	**1° Departments of Piura, Lambayeque,**	30,000
		y Ancash	
		Valle de San Lorenzo:	
		Tambogrande, Sullana.	
5	BRAZIL	**1°. STATES OF PERNAMBUCO AND BAHIA.**	25,000
		Eje Petrolina-Juazeiro.	
		(Valle del río San Francisco)	
		Municipalities:	
		Petrolina, Santa María de Buena Vista,	
		Belén de San Francisco, lago grande,	
		Orocó, Casa Nova, Sobradinho, Juazeiro, and	
		Curacá.	
		TOTAL	**90,000**

FIGURE 57:

IDENTIFICATION OF MANGO PRODUCTION AREAS

11.1.3 Failure to implement a regional plan for the establishment, declaration, and recognition of these 90,000 ha as fruit fly free zones would mean economic impacts to production and additional costs due to the hot water treatment of around US$ 198 million dollars each year. Refer to Table 41

TABLE 41:

ECONOMIC IMPACT OR DAMAGE BY MOSCAFRUT / AREAS THAT EXPORT TO THE US. YEAR 2020

No.	REGION	Hectáreas Afectadas	Cajas 4kgs Exp. Anual	Perdidas Kgs/Ha	Precio US $/ kg	Costo US $/Caja	Total (US $)
1	Dano economico a la produccion	90,000		1,500	1		135,000,000
2	Costo tratamiento Hidrotermico		180,000,000			0.35	63,000,000
TOTAL		**90,000**	**180,000,000**				**198,000,000**

11.1.4 Having fruit fly free areas improves the competitiveness for mango production and exports to the US.

11.2 SPECIFIC BY COUNTRY

11.2.1 Mexico

11.2.1.1 Within the north–south strategy for the control, eradication, and establishment of free areas driven by the National Fruit Fly Plan, the State of Sinaloa has twelve municipalities with international recognition by the USDA as fruit fly free areas.

Nevertheless, to date, only the municipalities of Ahome, El Fuerte, Choix, Guasave and Sinaloa de Leyva are exporting a yearly average of 60,000 metric tons of mangos without hot water treatment from approximately 5,680 ha of mango production area.

The other seven municipalities, Mocorito, Angostura, Salvador Alvarado, Badiraguato, Culiacán, Navolato and Elota, have not reported exports of mangos without the hot water treatment, despite the fact that they collectively have an average of approximately 1,000 ha of mango production area.

11.2.1.2 Continuing with the north – south fruit fly control and eradication strategy, the following six municipalities of Cosala, San Ignacio, Mazatlán, Concordia, Rosario and Escuinapa, that collectively amount to approximately 25,000 ha of mango production area, have been declared low fruit fly prevalence zones.

11.2.1.3 The other 22 States of the Mexican Republic, where there are mango production areas, are Mediterranean fruit fly free, but have recorded the presence of other fruit flies, especially of the Anastrepha genus.

11.2.2 Guatemala

11.2.2.1 Based on a priority ranking, the mango production areas in Guatemala that could export mangos without hot water treatment to the US, with great potential to be recognized by the US as fruit fly free areas in a period of no more than five years, are located in the Municipalities of Retalhuleu and Champerico, in the Department of Retalhuleu, La Máquina in Suchitepéquez, El Jícaro in El Progreso, and Teculután, Río Hondo, Huité and Estanzuela in Zacapa.

11.2.2.2 The Department of Petén is a Mediterranean fruit fly free area, internationally recognized by the USDA, in which the government of Guatemala, through it official agencies, has determined the existence of 62,000 ha that are suitable for mango production.

11.2.3 Ecuador

11.2.3.1 The areas that are free of Anastrepha grandis are located in the Provinces of: Santa Elena and Guayas.

11.2.3.2 The Mediterranean fruit fly free areas are located in:

a) The Province of Cotopaxi, in the Cantons of Lacatunga, Salcedo and Pujilí, located at 2,500 m above sea level, where 125,285 ha have been declared Mediterranean fruit fly free areas.

b) In part of the Palora Canton in the Province of Morona Santiago, there are 59,328 ha.

11.2.3.3 The low fruit fly prevalence areas are located in:

a) In Tungurahua, a low prevalence area for Anastrepha fraterculus. This area covers the following Cantons: Ambato, Tisaleo, Mocha, Quero, Cevallos, Píllaro and Pelileo, at altitudes ranging between 2,500 and 3,500 meters.

b) 186,377 ha of low prevalence for Ceratitis capitata in the Cantons of Quevedo, Buena Fe and Valencia from the Province of Los Ríos

c) In Canton Mejía there is an area of low prevalence for Ceratitis capitata, as an alternative for pest risk management for export operations.

11.2.3.4 In the republic of Ecuador, there are approximately 10,000 ha of mango production areas, of which 5,400 ha export product to various destinations, with a yearly export average in 2020/2021 of 49,000 metric tons, of which 46,000 metric tons (94%) were exported to the US.

11.2.3.5 Mango production and exports to the US are concentrated in the Province of Guayas (95%), in the parishes and Cantons of: El Consuelo, Chongón, Palestina, and Empalme.

In this province of Guayas, actions will have to be prioritized to continue strengthening fruit fly control and eradication activities to ensure the official declaration of fruit fly free areas within a reasonable amount of time.

11.4 Peru

11.4.1 There are approximately 32,000 ha of mango production, 70% of which are located in the coastal valley of the northern region, specifically in the valleys of San Lorenzo, Tambogrande, Chulacanas and Sullana, in the Department of Piura.

11.4.2 Since 1998, SENASA of the MINAGRI, through the Sub-directorate of Fruit Fly Control, implemented the National Fruit Fly Prevention, Detection, Control, and Eradication Program, with a strategy that consisted of moving gradually in a south to north trajectory to start in the Department of Tacna and Moquegua, and finishing in the department of Piura and Tumbes.

11.4.3 According to the information provided by SENASA and MINAGRI, it is estimated that by the end of the year 2023 the entire Pacific coast will be declared fruit fly three areas. This area is where the mango production zones are found, and the fruit produced there could be exported to the US without the need for the application of the hot water treatment.

11.4.4 The mango production areas in the Valle de San Lorenzo, District of Tambogrande in the Province and Department of PIURA, have great potential to be recognized by the US as fruit fly free areas in a period of no more than five years. Additionally, the Departments of Lambayeque, Cajamarca, La Libertad and Ancash.

11.5 Brazil

11.5.1 The largest center of the Brazilian fruit farming sector is made up of the Petrolina-Juazeiro (Valle de San Francisco) corridor, from where 90% of the mangos from Brazil are exported.

11.5.2 Currently, Valle de San Francisco Report an approximate mango production area of 40,000 ha.

11.5.3 Mango production areas in Brazil that could export mangos without the quarantine hot water treatment to the US, with potential to be recognized by the US as fruit fly free areas, are located in the State of Pernambuco and Bahía, in the aforementioned Valle de San Francisco.

11.5.4 In Valle de San Francisco there are already Mediterranean fruit fly suppression programs being undertaken and, starting in 2015, the program was carried out to combat other species of fruit flies. Thus, it now has the institutional framework adequate for that purpose.

12.1 GENERAL

12.1.1 Given that there are already proven solutions for the technical framework at the international level, the recommendation is for the Latin American region, through the respective ministries and departments of agriculture of the US, Mexico, Guatemala, Ecuador, Peru, and Brazil, along with the support of Exporter Associations, the National Mango Board (NMB), International Regional Agricultural Health Organization (OIRSA), FAO, International Atomic Energy Agency (AIEA) and other corresponding international organizations, to implement the strategic plan for the "ESTABLISHMENT AND RECOGNITION OF FRUIT FLY FREE ZONES FOR MANGO (Mangifera indica) PRODUCTION AND EXPORT AREAS FROM THE AMERICAS TO THE US" for the 2022–2036 period (15 years), which will allow for the execution of projects and actions that will contribute to the development and expansion of mango exports through the establishment, declaration, and recognition by the USDA of these mango production fruit fly free zones in Latin American territories.

The implementation and execution of the ALMA-MANGO Strategic Plan in three five-year phases will allow the United States of America, within a timeframe of no more than 5 years (first phase), to import a minimum of 250,000 metric tons of mangos on a yearly basis, during every month of the year and without the mandatory hot water treatment, from an additional 30,000 ha of mango fruit fly free zones in Mexico, Guatemala, Ecuador, Peru, and Brazil.

Phases II and III, with a duration of five years each, will allow for the recognition of a total of 90,000 ha of mango production areas as fruit fly free zones. (Refer to Table 42).

12.1.2 Provide support to the NPPOs (National Phytosanitary Protection Organizations) of the countries as necessary, in order to to carry out the development and implementation of the

official standard for the establishment of fruit fly free areas, in accordance with international standards.

TABLE 42:

PROGRESSIVE STRATEGIC PLAN FOR THE ESTABLISHMENT OF MANGO PRODUCTION FRUIT FLY FREE AREAS. 2022-2036.

No.	COUNTRY	TOTAL AREA (HAS)	5 YEARS (2022-2026) / PHASE 1	5 YEARS (2027-2031) / PHASE 2	5 YEARS (2032-2036) / PHASE 3
1	Mexico	25,000	5,000	10,000	10,000
2	Guatemala	5,000	5,000	0	0
3	Ecuador	5,000	5,000	0	0
4	Peru	30,000	10,000	10,000	10,000
5	Brazil	25,000	5,000	10,000	10,000
	TOTAL	**90,000**	**30,000**	**30,000**	**30,000**

Source: Research team.

12.2 SPECIFIC BY COUNTRY

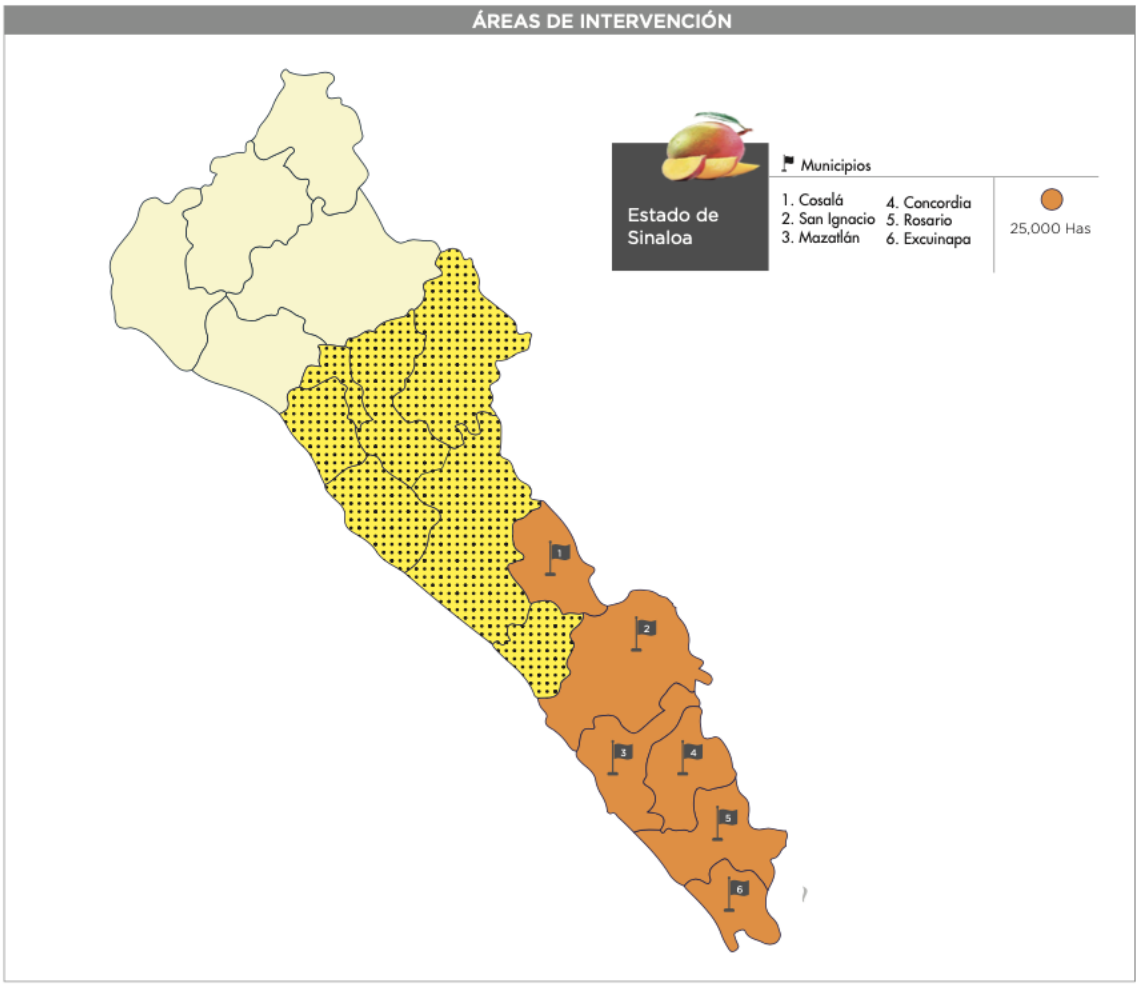
12.2.1 Mexico

12.2.1.1 Continue with the north-south fruit fly control and eradication strategy and strengthen the phytosanitary management actions in the municipalities of Cosalá, San Ignacio, Mazatlán, Concordia, Rosario and Escuinapa, in order to establish, declare, and recognize 25,000 ha as fruit fly free areas in the medium term. (Refer to Figure 58).

FIGURE 58:

Source: Research team.

FIGURE 58:



12.2.2 Guatemala

12.2.2.1 Implement the Strategic and corresponding Operational Plans in order to establish, declare, and recognize 5,000 ha as fruit fly free areas, during a period of no more than five years, in the Departments of Retalhuleu, Suchitepéquez, El Progreso and Zacapa. (Refer to Figure 59)

12.2.2.2 Strengthen the actions of the MOSCAMED and MOSCAFRUT programs in the Departments of El Progreso and Zacapa, locations where high yield and high quality mangos are produced and exported to the US.

12.2.2.3 Implement a fruit fly detection program in the mango production zones in the departments of Santa Rosa and Jutiapa, in order to establish the status of these pests in these regions.

12.2.2.4 Identify in the Department of Petén an area of 1,000 ha to foster mango production, capitalizing on the status of the area as a Mediterranean fruit fly free zone, internationally recognized by the USDA.

12.2.2.5 Carry out the corresponding official actions to ensure that the Champerico and Retalhuleu regions are internationally recognized by the USDA as Mediterranean fruit fly free areas.

12.2.2.6 Develop the protocol, or the joint work program between MAGA-USDA that can be used for the implementation of the application of the Fruit Fly Free Areas, Sites, and Locations concept at the national level, the instrument by which mangos can be exported from Guatemala to the US without hot water treatment.

FIGURE 59:

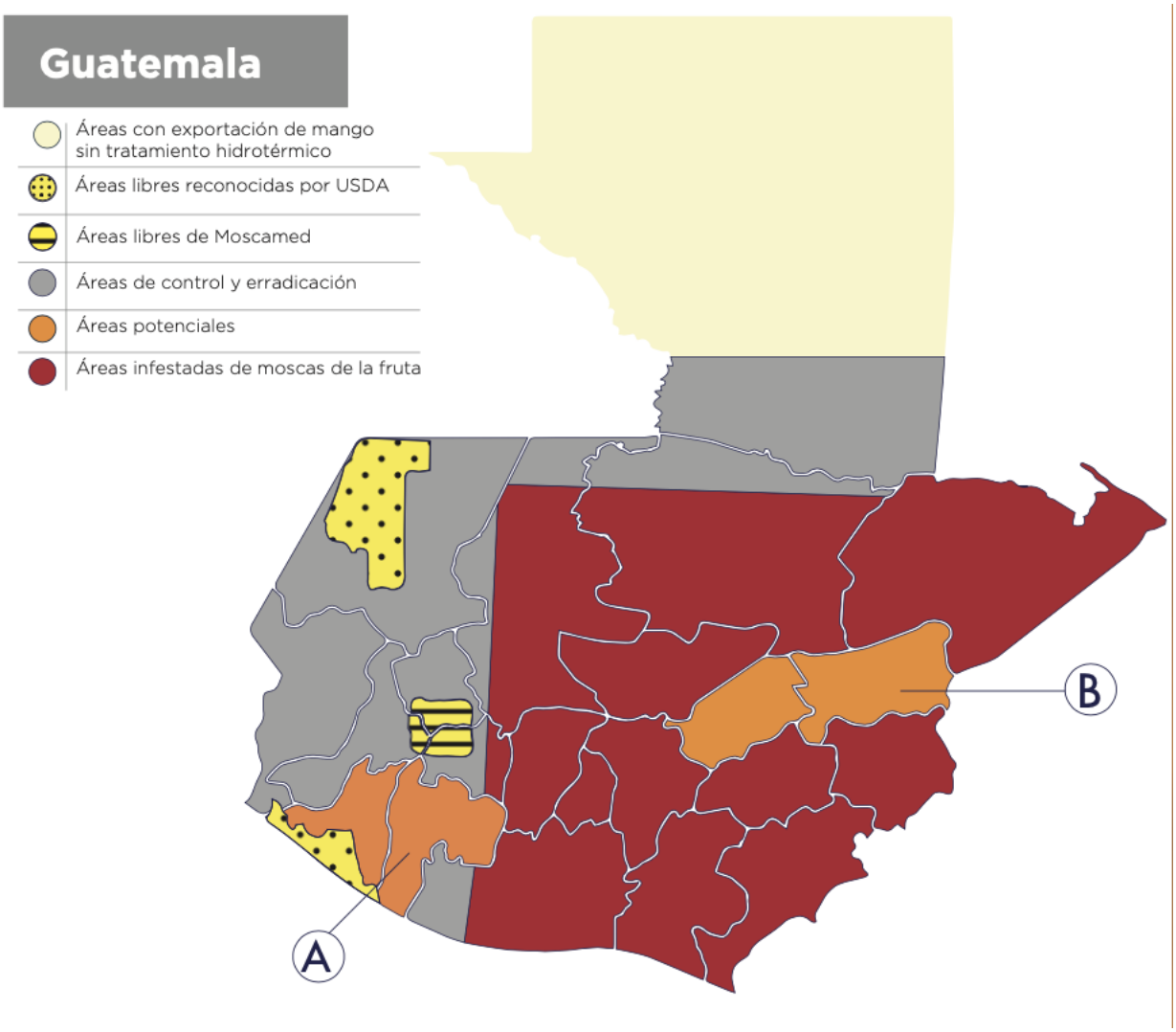
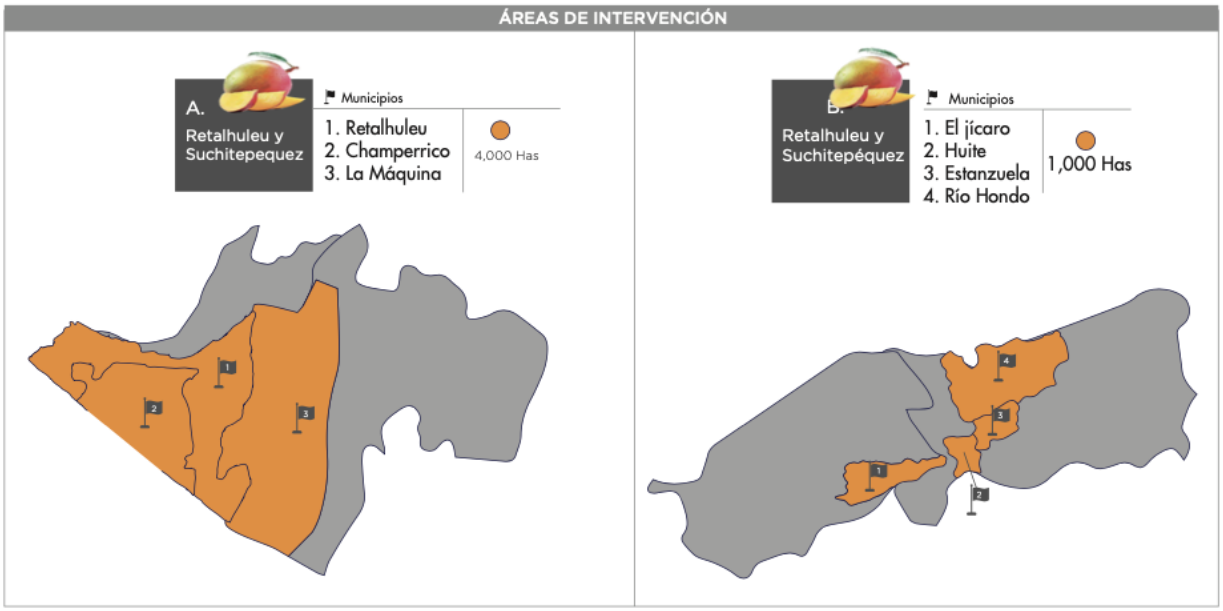


FIGURE 59:



12.2.3 Ecuador

12.2.3.1 Carry out the corresponding official actions to strengthen fruit fly control and eradication measures in the Province of Guayas, with a focus on the parishes and Cantons of El Consuelo, Chongón, Palestina and Empalme. (Refer to Figure 60).

FIGURE 60:

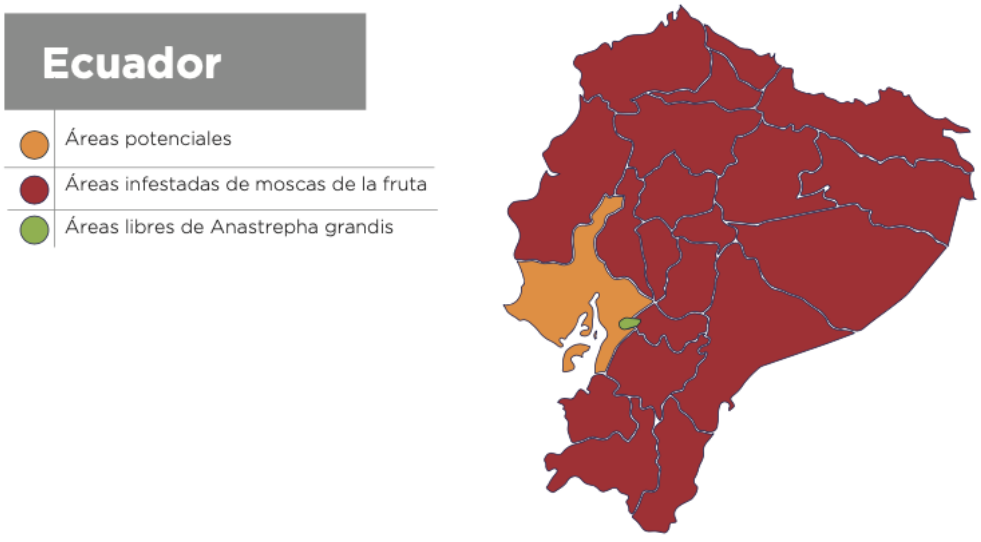
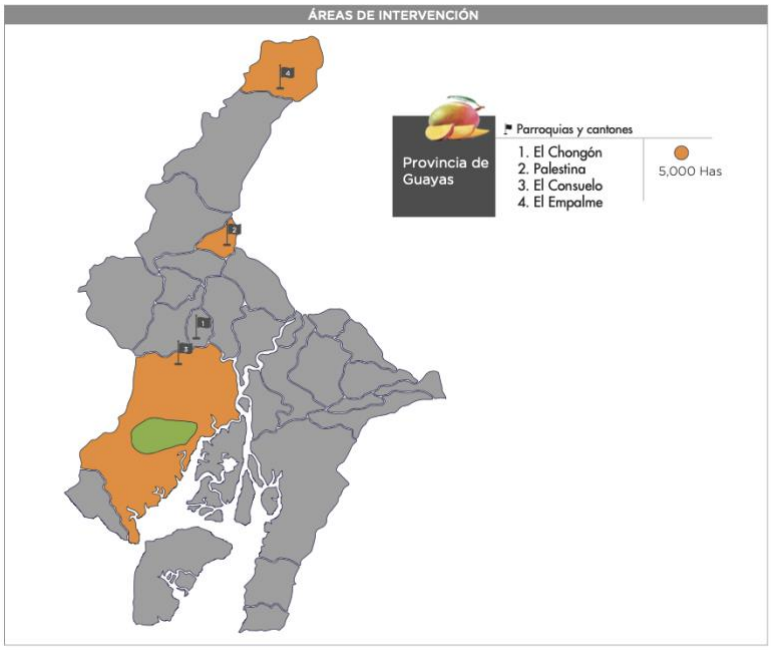


FIGURE 60:

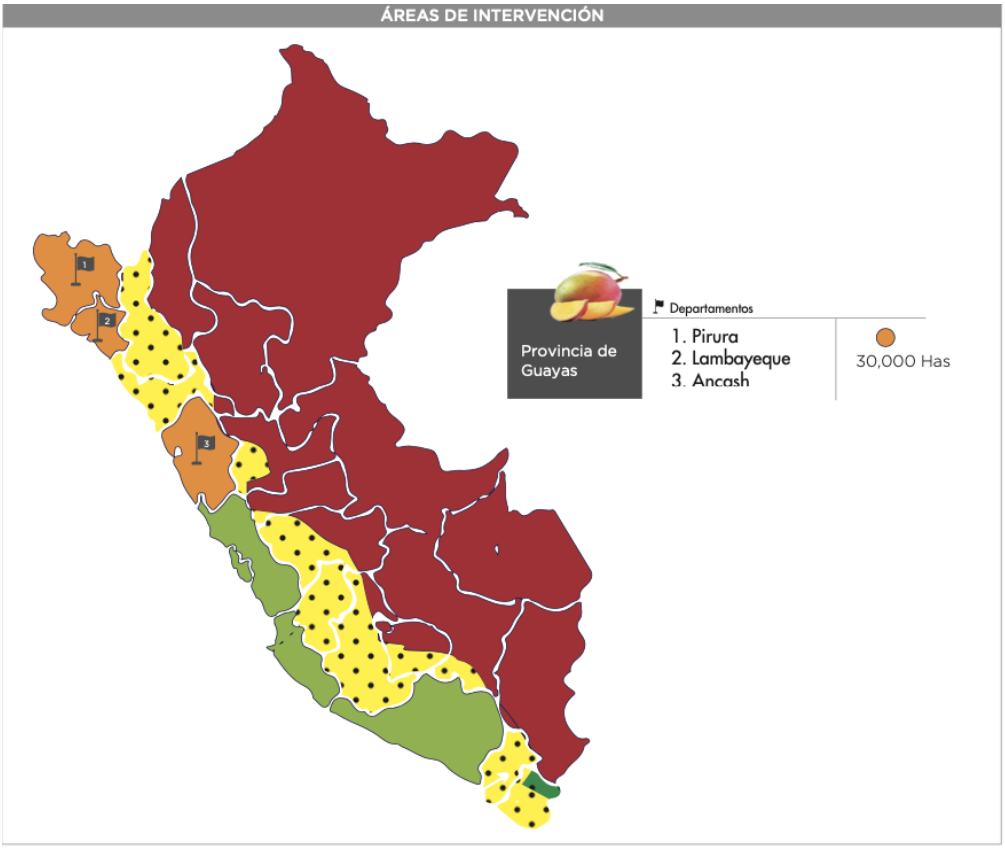


Source: Research team.

12.2.4 Peru

12.2.4.1 Carry out the corresponding official actions to ensure that the departments with the highest levels of mango production: Piura, Lambayeque, Cajamarca, Ancash and La libertad, are internationally recognized by the USDA as fruit fly free areas. (Refer to Figure 61)

FIGURE 61:



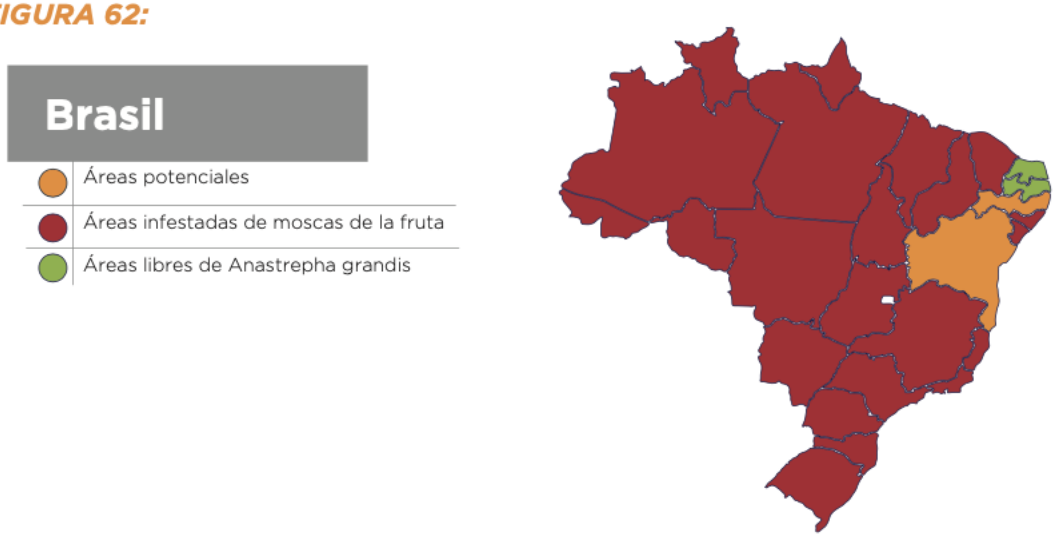
Source: Research team.

12.2.5 Brazil

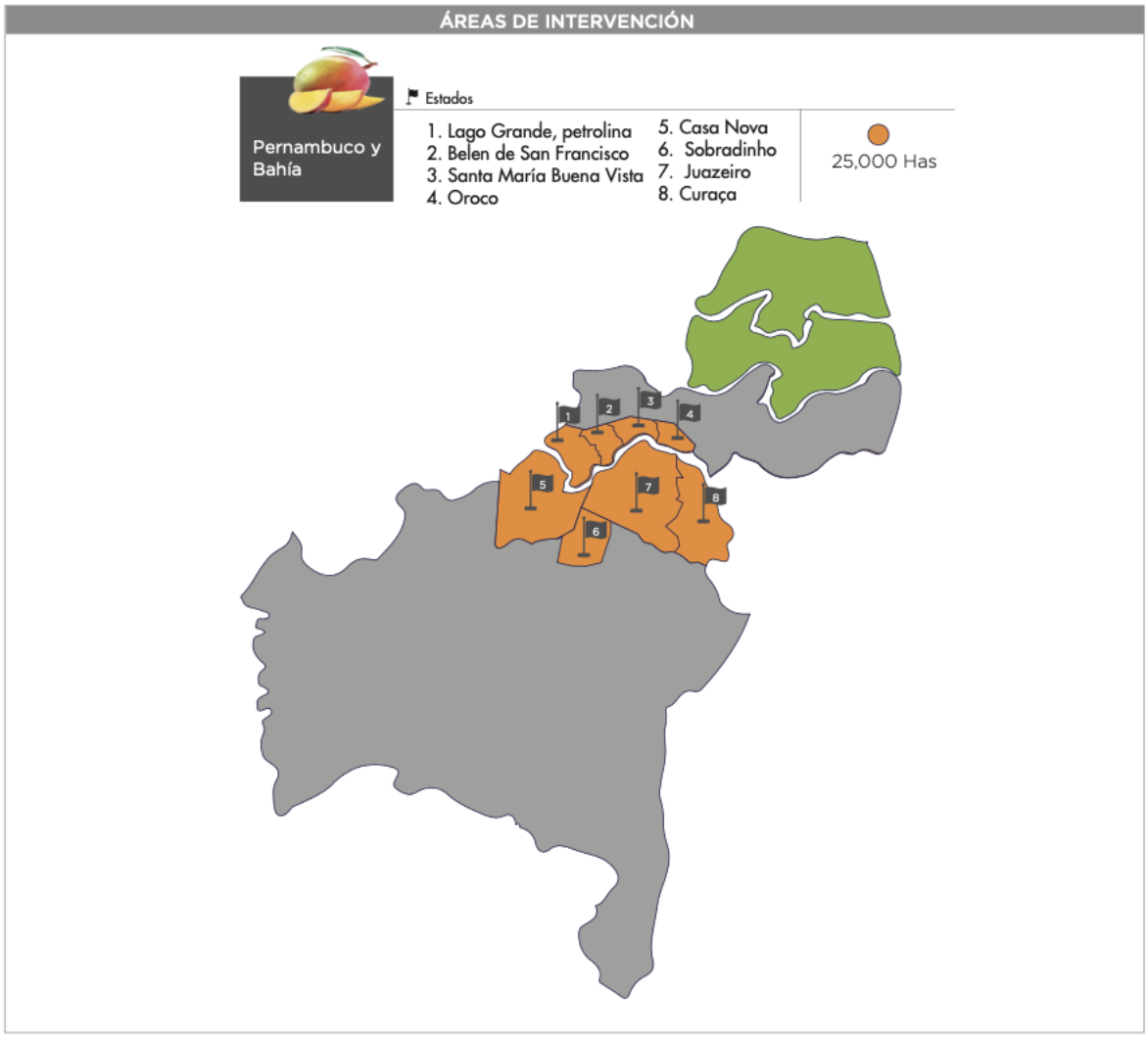
12.2.5.1 Carry out the corresponding official actions to strengthen fruit fly control and eradication measures in the area of Valle de San Francisco. (Refer to Figure 62).

12.2.5.2 Develop the protocol, or the joint work program between MAGA-USDA, to be able to export mangos to the US without hot water treatment.

FIGURA 62:



Source: Research team.



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Attachments 1,2, and 3 correlate with specific objective number 4, that refers to the necessary step-by-step measures that need to be undertaken to garner the support of national, international, and private organizations for the development and implementation of a program to establish fruit fly free areas that are recognized by the US.

14.1 Attachment 1

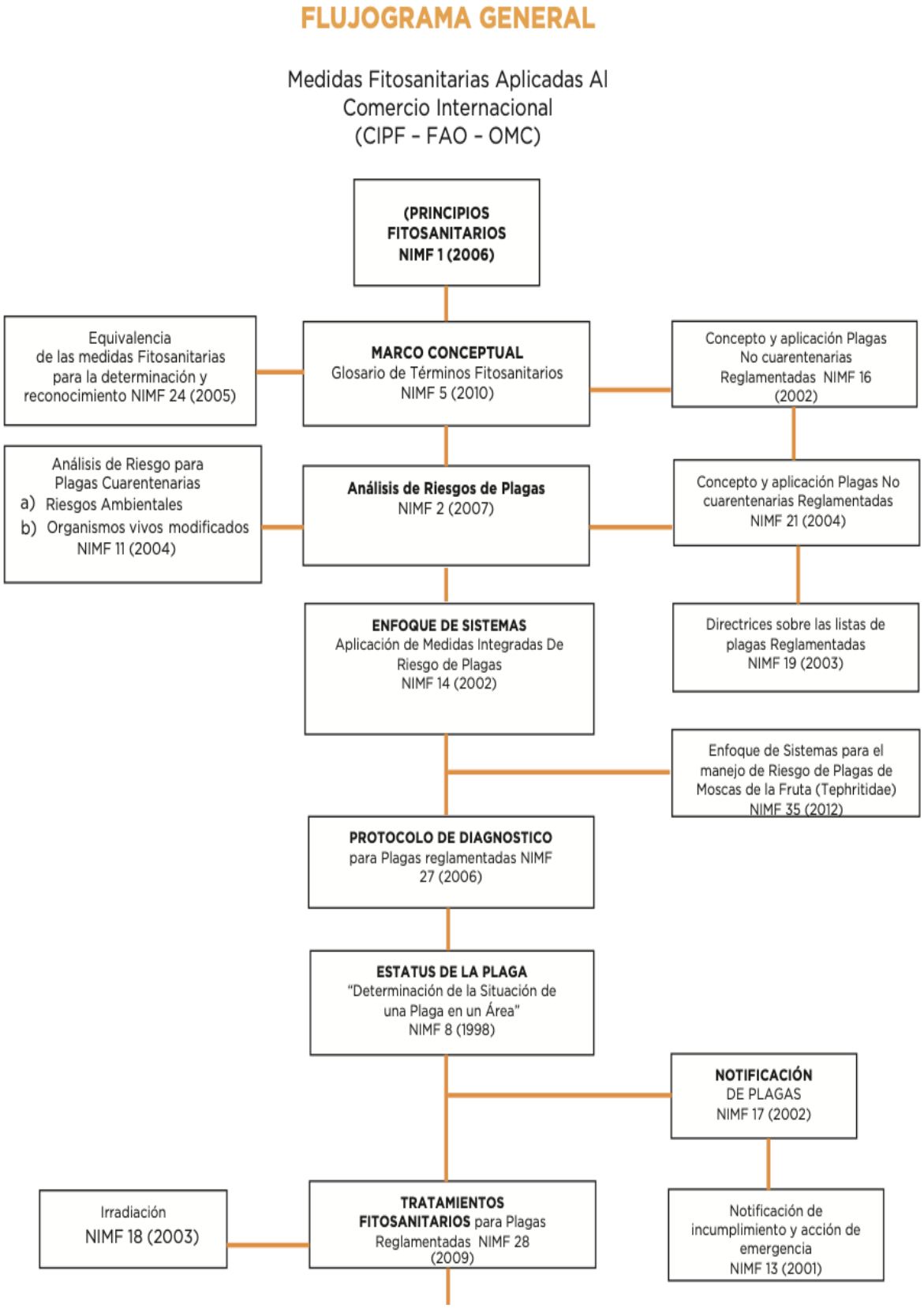
GENERAL FLOW CHART OF PHYTOSANITARY MEASURES APPLIED TO INTERNATIONAL TRADE.

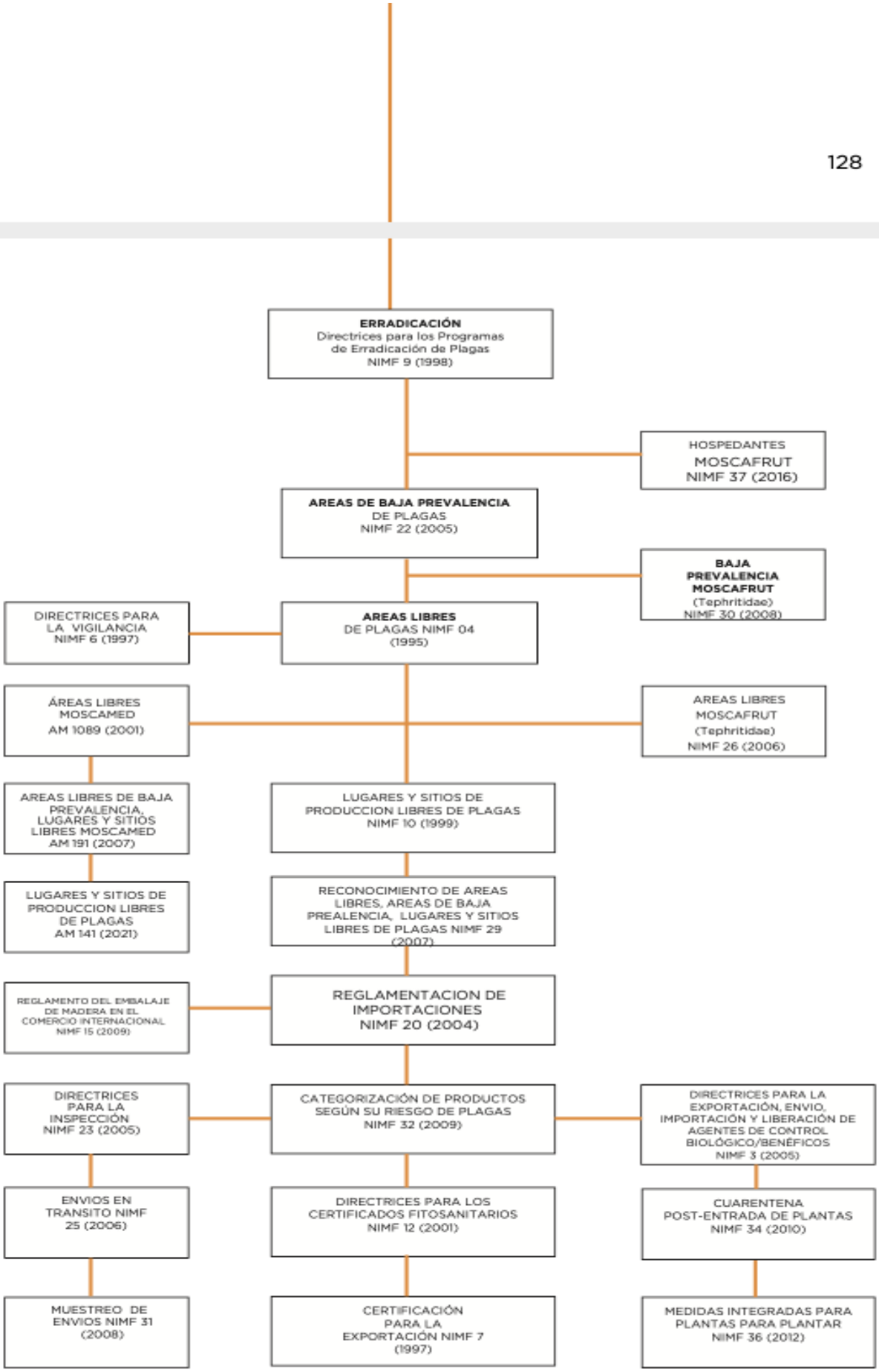
This flow chart shows a summary of the International Standards for Phytosanitary Management (ISPM) that have been issued by the International Phytosanitary Protection Commission (IPPC) to be applied in support of international trade.

ISPMS STANDARDS ARE NOT REGULATORY INSTRUMENTS IN AND OF THEMSELVES, BUT INSTEAD GO INTO EFFECT WHEN GOVERNMENT ESTABLISH REQUIREMENTS IN THEIR NATIONAL LEGISLATION.

GENERAL FLOWCHART

Phytosanitary measures applied to international trade (IPPC – FAO – WTO).




ERRADICACIÓN
Directrices para los Programas de Erradicación de Plagas
NIMF 9 (1998)
HOSPEDANTES
MOSCAFRUT
NIMF 37 (2016)
AREAS DE BAJA PREVALENCIA
DE PLAGAS
NIMF 22 (2005)
BAJA PREVALENCIA MOSCAFRUT
(Tephritidae)
NIMF 30 (2008)
DIRECTRICES PARA LA VIGILANCIA
NIMF 6 (1997)
AREAS LIBRES
DE PLAGAS NIMF 04
(1995)
ÁREAS LIBRES MOSCAMED
AM 1089 (2001)
AREAS LIBRES MOSCAFRUT
(Tephritidae)
NIMF 26 (2006)
AREAS LIBRES DE BAJA PREVALENCIA, LUGARES Y SITIOS LIBRES MOSCAMED
AM 191 (2007)
LUGARES Y SITIOS DE PRODUCCION LIBRES DE PLAGAS
NIMF 10 (1999)
LUGARES Y SITIOS DE PRODUCCION LIBRES DE PLAGAS
AM 141 (2021)
RECONOCIMIENTO DE AREAS LIBRES, AREAS DE BAJA PREALENCIA, LUGARES Y SITIOS LIBRES DE PLAGAS NIMF 29
(2007)
REGLAMENTO DEL EMBALAJE DE MADERA EN EL COMERCIO INTERNACIONAL
NIMF 15 (2009)
REGLAMENTACION DE IMPORTACIONES
NIMF 20 (2004)
DIRECTRICES PARA LA INSPECCIÓN
NIMF 23 (2005)
CATEGORIZACIÓN DE PRODUCTOS SEGÚN SU RIESGO DE PLAGAS
NIMF 32 (2009)
DIRECTRICES PARA LA EXPORTACIÓN, ENVIO, IMPORTACIÓN Y LIBERACIÓN DE AGENTES DE CONTROL BIOLÓGICO/BENÉFICOS
NIMF 3 (2005)
ENVIOS EN TRANSITO NIMF
25 (2006)
DIRECTRICES PARA LOS CERTIFICADOS FITOSANITARIOS
NIMF 12 (2001)
CUARENTENA POST-ENTRADA DE PLANTAS
NIMF 34 (2010)
MUESTREO DE ENVIOS NIMF 31
(2008)
CERTIFICACIÓN PARA LA EXPORTACIÓN NIMF 7
(1997)
MEDIDAS INTEGRADAS PARA PLANTAS PARA PLANTAR
NIMF 36 (2012)

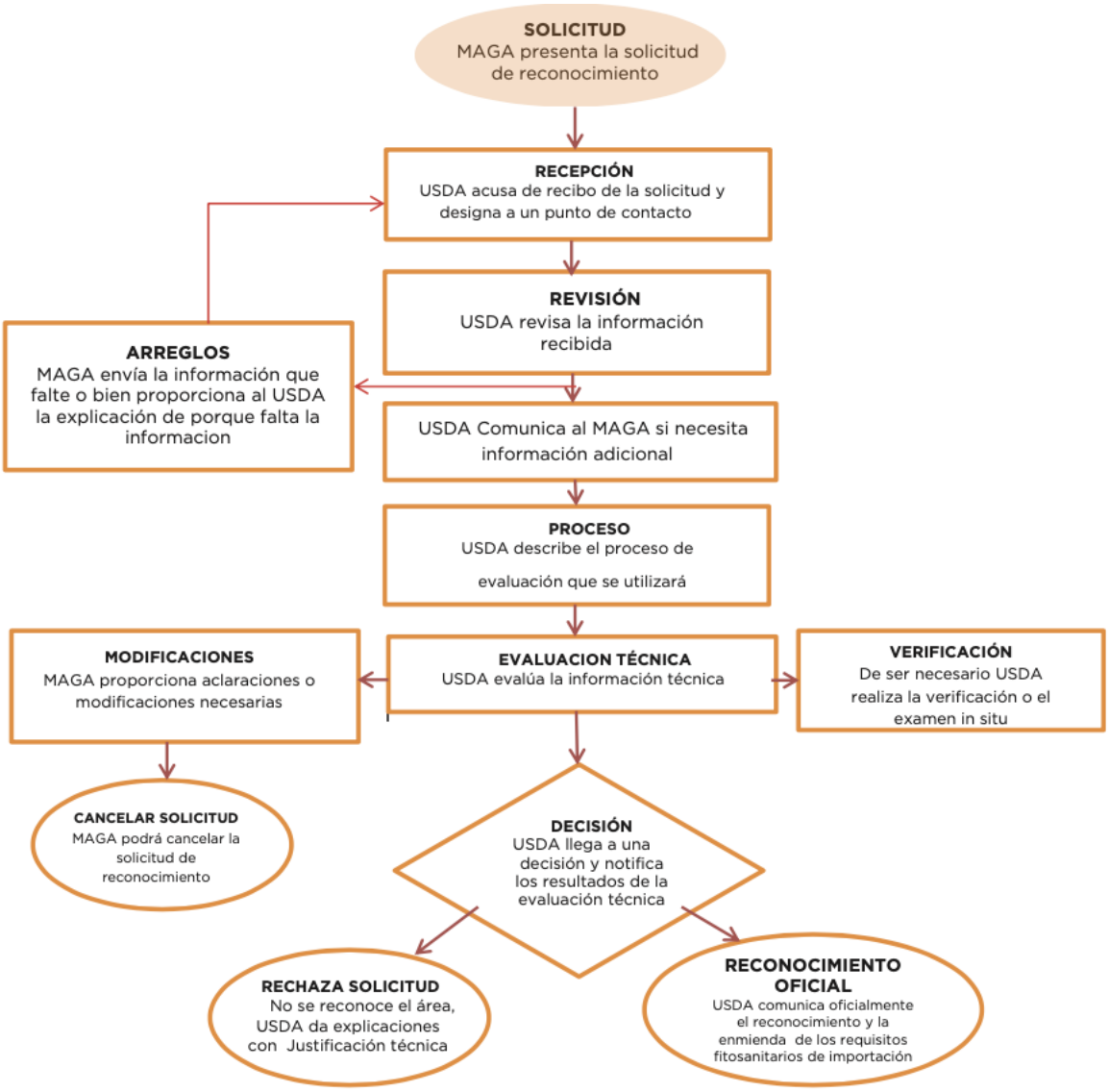
14.2 Attachment 2

GENERAL FLOWCHART SHOWING FRUIT FLY FREE AREAS.

This flow chart shows a summary of the steps that need to be implemented in order for the US to recognize fruit fly free areas. The case study example of existing agencies in Guatemala is used.

General flowchart

Recognition of Fruit Fly Free Areas



Procedure based on international and Guatemalan phytosanitary management standards.

14.3 Attachment 3.

STRATEGIC PLAN, 2022-2036. RECOGNITION OF FRUIT FLY FREE ZONES FOR MANGO (MANGIFERA INDICA) PRODUCTION AND EXPORT AREAS FROM THE AMERICAS TO THE US (ALMA-MANGO).

Outlines the activities that need to be implemented for the establishment and the declaration of fruit fly free areas.

NATIONAL MANGO BOARD (NMB)

STRATEGIC PLAN 2022-2036

RECOGNITION OF FRUIT FLY FREE ARES IN MANGO (Manguífera indica) PRODUCTION AND EXPORT ZONES FROM THE AMERICAS TO THE US (ALMA-MANGO).

ROGER VALENZUELA

(Consultant on Fruit Health)

Guatemala, November 2021.

SUMMARY

The largest exporters of mangos to the US are Mexico, Guatemala, Ecuador, Peru, and Brazil, since these countries possess soil and climate conditions, experience, and suitable technology to produce and export high quality fresh mangos to the US.

During the 2020-2021 export season, the mango production areas that export to the US amounted to a total surface area of 65,853 hectares, from which 520,000 metric tons of mango are produced.

Currently, 13.5% of the total volume of mangos exported to the US each year is produced only on 5,680 ha, which is equivalent to 69,893 metric tons annually, that come from fruit fly free zones located in the state of Sinaloa, Mexico. These areas have USDA international recognition and, therefore, can export product without the need for the quarantine hot water treatment.

In the remaining 60,173 ha of mango production, distributed among the countries of Mexico, Guatemala, Ecuador, Peru, and Brazil, the production is approximately 450,000 metric tons per year, equivalent to 86.5% of mango exports to the US.

These receive the quarantine hot water treatment to avoid any risk of fruit fly infestation.

The National Mango Board (NMB) commissioned a research project in 2021 entitled "***Identification of mango production areas with potential to be declared fruit fly free zones or farms with low fruit fly prevalence in the five main mango producing countries that export to the US.***"

The research project identified 90,000 hectares of mango production areas with a high potential to be established as fruit fly free zones.

The National Mango Board (NMB) believes it is timely and necessary to expand mango exports to the US that are sourced from fruit fly free zones.

Given that there are already proven solutions for the technical framework at the international level, the recommendation is for the countries of Mexico, Guatemala, Ecuador, Peru, and Brazil --through their respective ministries and departments of agriculture and national phytosanitary protection organizations (NPPO)-- along with the support of exporter associations, the National Mango Board (NMB), OIRSA, FAO, AIEA and corresponding international organizations, to implement the strategic plan for the **"RECOGNITION OF FRUIT FLY FREE ZONES FOR MANGO (Mangifera indica) PRODUCTION AND EXPORT AREAS FROM THE AMERICAS TO THE US (ALMA-MANGO)** for the 2022–2036 period (15 years), through which projects and actions can be executed to contribute to the development and expansion of mango exports through the establishment, declaration, and recognition of these fruit fly free zones by the USDA.

The implementation and execution of the ALMA-MANGO Strategic Plan will allow the United States of America (US), during a period of no more than 15 years, to import a minimum of 250,000

metric tons of mangos every month of the year, without the mandatory hot water treatment, from 30,000 ha of mango fruit fly free zones in Mexico, Guatemala, Ecuador, Peru, and Brazil. The equivalent of 50% the total area that exports to the US.

1. INTRODUCTION

Mexico, Guatemala, Peru, Ecuador, and Brazil have soil and weather conditions that are suitable for mango production and, according to the respective ministries of agriculture of each one of these countries, collectively have 334,685 ha of mango production area. Of these, 65,853 ha (20%) produce, process, and export product exclusively to the US.

In order to be able to process and export mangos from areas that have the presence of fruit flies to the US, packinghouses previously needed to comply with the application of the mandatory quarantine hot water treatment, which is a systems approach mitigation measure (FAO, 2009, ISPM 14).

This means that the fruit must be subjected to a quarantine hot water treatment to eliminate these pests before it is exported to the US and, although there are various alternative quarantine treatments such as: high temperature forced air treatment, high temperature forced air with controlled environment, and irradiation, the hot water treatment (immersing the fruit in hot water) is actually the least costly and most widely utilized measure by all of the countries that export mangos to the US.

Nevertheless, the majority of mango consumers in the US, and many mango industry members, have expressed concern that the hot water treatment is one of the reasons that mango quality is frequently deficient.

As a result, the main challenge for exporter association mango committees, undoubtedly, is the improvement of the general quality of export mangos.

Offering higher quality fruit in retail stores in the US will lead to an increase in sales and, in time, an increase in the demand for mangos from fruit fly free areas.

Therefore, in order to satisfy consumers in the US and at the same time be in full compliance with USDA requirements from the standpoint of reducing the risk of fruit flies entering the US, this Strategic Plan proposes that all the mango production areas that export product to the US (equivalent to 65,000 ha) be declared and recognized as free of these pests.

This is the most intelligent measure that the governments of Mexico, Guatemala, Peru, Ecuador, and Brazil, in partnership with mango producer and exporter sectors that export mangos to the US, need to implement in order to foster the export of high-quality fruit, job creation, and stable profits.

To that end, it will be necessary for the ministries of agriculture to strengthen the actions of their respective departments of plant health, in order to ensure that they have the necessary financial

resources to develop a strategic plan for a National Fruit Fly Control and Eradication Program (MOSCAFRUT), in conjunction with the mango committees of the various countries, so that in a period not to exceed 15 years the mango production and export areas that ship to the US can be declared fruit fly free zones by the NPPOs and be recognized by the USDA.

We recommend, for the 2022–2036 period (15 years), the execution of the Strategic Plan: "RECOGNITION OF FRUIT FLY FREE ZONES FOR MANGO (Mangifera indica) PRODUCTION AND EXPORT AREAS FROM THE AMERICAS TO THE US (ALMA-MANGO).

Through the successful execution of ALMA-MANGO, the goal of exporting a minimum of 62.5 million boxes (250,000 MT) of mangos to the US without the need for the application of the hot water treatment can be reached, from 30,000 hectares.

2. JUSTIFICATION

For the United States of America, the existence of fruit fly control and eradication programs, including MOSCAMED, in Mexico, Guatemala, Peru, Ecuador, and Brazil would reduce the possibilities that the States of Florida and California would suffer infestations and, therefore, avoid the eradication costs in those States.

The ALMA-MANGO strategic plan is broadly justified within the technical and financial cooperation framework established with the USDA, for each one of the five main producing countries that export mangos to the US.

In the particular case of Guatemala, it has been collaborating with the US for over 45 years in maintaining a containment barrier that keeps Ceratitis capitata (MOSCAMED) from traveling north along the continental path toward the northern part of the American continent.

Additionally, mango exports without hot water treatment could be increased and used to generate more income and create more jobs for Guatemalan mango production areas.

The mango fruit fly (Anastrepha oblicua), is a part of the Tephritidae family of the fruit fly species (MOSCAFRUT), which includes the Mediterranean fruit fly (Ceratitis capitata), Citrus fly (Anastrepha ludens), Zapote fly (Anastrepha serpentina), and Guava fly (Anastrepha estriata), all of which are considered pests that are of economic and quarantine importance for fruit farming in general and, in the particular case of mango production, can cause economic damage between 30 and 40% of the overall production.

Areas with mango production and exports to the US have infestations of fruit flies that, in addition to the direct economic harm that they can cause to the production, also lead to quarantine barriers which, in order to be able to export mangos to the US, require the mandatory application of a quarantine hot water treatment (immersion of the fruit in hot water) in mango packinghouses, that seriously affects the quality of the exported mangos.

Both factors, direct economic damage to production and the economic cost of the quarantine hot water treatment for exports, would represent a total annual economic loss of $128.9 million for mango growers and exporters.

This is estimated based on a baseline 15% of damage to production that equates to 1.5 metric tons/hectare, and an average US price of US $1/kg of fruit, for a total of 60,000 ha that currently produce and export mangos from the region that includes the five countries, as well as a cost of US $.35 per box of mangos for product subjected to the hot water treatment protocol (exported to the US in 2020-2021, 129.8 million boxes).

Currently, Mexico exports mangos to the US, without the application of the hot water treatment, during the period between weeks 24 and 40 (June – September), and it is estimated that Peru will be able to do the same beginning in 2023 during the period between weeks 44 and 8 (October to January).

To export mangos to the US without the application of the hot water treatment, the phytosanitary requirement that mango production farms must be production areas officially declared by the NPPO and recognized by the USDA as fruit fly free areas must be met.

All five countries, Mexico, Guatemala, Peru, Ecuador, and Brazil are signatories to the World Trade Organization Agreement (WTO), which contains provisions that refer to the application of sanitary and phytosanitary measures (SPS) that establish regulations related to food safety and animal and plant health control.

To access these specialized markets, improvements need to be made to the phytosanitary conditions of the fruit farming sector in the country, and solutions need to be developed to overcome the phytosanitary barrier related to the production and trade of fruit products. Part of the solution is to carry out production practices under the umbrella of official control programs in accordance with the requirements for the establishment of pest free production areas (AIEA, 2003).

As a strategy to address this need to expand regional trade exchange, the United Nations Food and Agriculture Organization introduced the concept of Pest Free Areas (PFA) for the production of plants and/or plant products that are subject to minimum phytosanitary restrictions (FAO, 2006).

It's important to highlight that the WTO authorizes countries to establish their own standards, and literally points out that regulations need to be based on scientific principles and, additionally, should only be applied in a manner necessary to protect the health and life of persons and animals, or to preserve plants.

For this reason, in order to execute a detection, control, and eradication program or project with NPPO oversight for the purpose of establishing and officially declaring fruit fly free areas, it will be necessary to have the corresponding standards for the National Phytosanitary Protection Office in place from the outset.

Because of this, support for NPPOs (National Phytosanitary Protection Organizations) cannot be delayed in order to carry out and put into effect the official standards in each one of the

countries, in accordance with the corresponding international standards, for the establishment of fruit fly free areas.

To be able to comply with the measures established by the NPPO and implement and maintain a pest free production area, an operational project must be executed.

For this reason, it will be necessary to formulate and execute a strategic plan in which, based on public-private partnerships, the agreement or bilateral arrangements can be established in such a way that they will list the necessary specific activities that include the functions and responsibilities of the producers, exporters, as well as the respective government offices in the mango producing countries and the US.

Therefore, it will be fundamentally necessary to strengthen the efforts currently being undertaken by NPPOs in the agricultural health field, especially in productive sectors that, like mangos, create sources of jobs and wealth in rural areas, but require support with the integrated management of pests such as fruit flies.

During the 2022–2036 timeframe, a goal was set to eradicate, declare, and internationally recognize Mediterranean fruit fly free areas as well as other fruit fly free areas, where mango production would not be subjected to quarantine restrictions in order to export to the US and other countries that have been declared fruit fly free.

3. OBJECTIVES

Expand mango production and exports without the need for the application of the hot water treatment to the US from areas recognized by the USDA as fruit fly free areas.

3.2 Specific:

3.2.1 Support NPPOs (National Phytosanitary Protection Organizations) that require assistance for the purpose of carrying out and putting into effect the official Guatemalan standards, in accordance with the corresponding international standards, for the establishment of areas and/or farms that are fruit fly free.

3.2.2 Eliminate non-tariff barriers, as well as other measures, that restrict mango exports to the US

3.2.3 Prevent, detect, identify, and establish the geographical distribution and levels of annual infestation of fruit flies in farms that produce and export mangos.

3.2.4 Expand the internal quarantine network to avoid the incursion of fruit flies into mango production locations and sites that are contained in areas that are officially declared by NPPOs as fruit fly free.

3.2.5 Carry out the categorization and certification of the status of any and all production and export sites and locations by the Office of Plant Health of the NPPO in order to establish, based on fruit fly trapping and sampling results, whether they are: a) Free, b) Low prevalence, c) Suppression, d) Monitoring and Control, e) Infested.

3.2.6 Implement sustainable actions that are environmentally and technically recommended, socially acceptable, and economically viable for the control, suppression, and eradication of fruit flies in mango production and export locations and sites.

3.2.7 Officially declare mango production and export locations and sites as fruit fly free by the NPPOs.

3.2.8 Request, process, and obtain the affirmative decision for the official recognition of fruit fly free areas from the USDA.

3.2.9 Carry out the respective technical and administrative maintenance of locations, sites, and fruit fly free areas in mango production and export operations that ship product to the US in Mexico, Guatemala, Ecuador, Peru and Brazil.

4. GOALS

4.1 30,000 hectares of mango production and exports from Mexico, Guatemala, Peru, Ecuador, and Brazil, recognized by the USDA as fruit fly free areas.

4.2 62.5 million boxes of mangos exported to the US without the need for hot water treatment.

5. CONCEPTUAL FRAMEWORK

The International Standards for Phytosanitary Measures (ISPM) are created by the office of the International Plant Protection Convention (IPPC), the international phytosanitary technical organization for the World Trade Organization (WTO), as part of the global policy and technical assistance program on plant quarantines implemented by the UN Food and Agriculture Organization (FAO).

This program offers these standards, guidelines, and recommendations to harmonize phytosanitary measures in the international arena to members of both the FAO as well as other interested parties for the purpose of facilitating trade and avoiding the use of unjustified measures such as trade barriers (FAO, 2009).

The contracting parties (countries) of the IPPC adopt the ISPM through the Phytosanitary Measures Commission. The ISPM are standards, guidelines, and recommendations that are recognized as the foundation for the development of phytosanitary measures that members of

the WTO can apply by virtue of the Agreement on The Application of Phytosanitary and Sanitary Measures (SPS Agreement) (FAO, 2009).

In the application of the SPS agreement, phytosanitary measures that are applicable to the import and/or export of plants, plant products, and other regulated items, must be technically and scientifically justified, which is reflected in the aforementioned phytosanitary requirements or conditions established by the NPPOs in the various countries.

The international standards for phytosanitary measures (ISPM) are standards, guidelines, and recommendations that are recognized as the foundation for the phytosanitary measures that members of the WTO can apply by virtue of the Agreement on The Application of Phytosanitary and Sanitary Measures (SPS Agreement).

The standards are not regulatory instruments in and of themselves, but rather go into effect when governments establish requirements in their national legislation (FAO, 2006).

According to the glossary of phytosanitary terms, a production area is one in which a specific pest is absent, as demonstrated by scientific evidence, and where, when appropriate, this status is officially being maintained (FAO, 2015).

The establishment and use of a PFA (Pest Free Area) by a NPPO (National Phytosanitary Protection Organization) foresees the export of plants, vegetable products, and other regulated items from the country in which the area is located (exporting country), to another country (importing country) without the need for the application of additional phytosanitary measures, under the condition that certain requirements are met (IPPC, 2016)

In this manner, the pest free status conferred to an area can be used as the basis for the phytosanitary certification of plants, vegetable products, and other regulated items corresponding to the pests in question.

It also stipulates, as an element of the pest risk assessment, the confirmation of the scientific foundation regarding the absence of a determined pest in an area (CIPF, 2016).

The concept of a PFA (pest free area) is one element of the justification for the phytosanitary measures to protect an area at risk undertaken by an importer country, one that imposes requirements for the establishment of fruit fly free zones under the category of “pest free areas” that can range from an entire country to a small area that is free of pests but located within a country where the pest is prevalent.

In this case, it should correspond to the biology of the pest in question (FAO, 2006). In practice, pest free areas (PFA) are generally demarcated by easily recognizable borders that, by and large, adequately coincide with the biological limits of a pest.

They could be administrative in nature (for example, national, provincial, or communal borders), physical characteristics (rivers, oceans, mountain ranges, highways), or property limits that are clearly defined by all parties.

6. BACKGROUND

6.1 FRUIT FLIES

Although the United States of America has Mediterranean fruit fly free zone phytosanitary status, it has experienced recurrent incursions of the pest since 1924 which has obliged it to maintain a rigorous monitoring program to avoid having the pest settle in their territory.

Currently, the US government participates in the MOSCAMED Tri-national Cooperation Program with Mexico and Guatemala to contain and, eventually, eradicate the Mediterranean fruit fly from Guatemala, which in turn would reduce the risk of invasion and settlement of the pest in Mexico and in the US.

The countries of Mexico, Guatemala, Ecuador, Peru, and Brazil have National Fruit Fly Control and Eradication Programs (MOSCAFRUT PROGRAM), all of which are attached to the plant health agencies of their respective Secretariat or ministries of agriculture.

The oldest historical precedent of fruit fly control and eradication programs dates back to the year 1975, when Guatemala and Mexico established the MOSCAMED Commission to control and eradicate Ceratitis capitata in Guatemalan territory.

Mexico established the MOSCAMED program in 1977 and, by 1982, had been declared Mediterranean fruit fly free, the phytosanitary status that it maintains to this very day.

In 1992, Mexico subsequently established the MOSCAFRUT program to control other fruit flies of the Anastrepha genus, specifically, the species: oblicua, ludens, striata and serpentina.

Recently, the program was established in Guatemala in 2011, followed by Ecuador and Peru in 2014 and, finally, by Brazil in 2015.

6.2 MANGO PRODUCTION AND EXPORTS

According to information provided by the Secretariats and Ministries of Agriculture, the National Phytosanitary Protection Organizations (NPPO), the National Fruit Fly Control and Eradication Programs (MOSCAFRUT), the mango exporter associations, and the departments of fruit farming, which include promoting mango production, there are currently 65,853 ha of mango production that export specifically to the US.

Currently, of the total number of hectares dedicated to the export of mangos to the US, only 5,680 ha (8.63%) have been recognized by the USDA as fruit fly free areas.

From these free areas, located in municipalities in the northern part of the state of Sinaloa, Mexico, 69,893 metric tons of mangos are exported to the US without the need for the application of the postharvest hot water treatment.

This export volume, not subject to the mandatory quarantine hot water treatment, corresponds to 13.5% of the total of 516,492 metric tons of mangos exported to the US (Refer to Table 1).

TABLE 1:

No.	COUNTRY	EXPORTS TO THE US MT	EXPORTS FROM FREE AREAS MT	PERCENTAGE OF FREE AREAS (%)
1	MEXICO	332,921	69,893	20.99386942
2	PERU	74,882	0	0
3	BRASIL	49,957	0	0
4	ECUADOR	46,110	0	0
5	GUATEMALA	15,662	0	0
TOTAL		**519,532**	**69,893**	**13.5323**

Table 2 shows a more detailed view of the behavior of the national exports from the countries of Mexico, Guatemala, Ecuador, Peru and Brazil.

In total, during the 2020 season, 129.8 million 4kg boxes were exported to the US.

Mexico exports 64% of the total exports to the US from all five countries

TABLE 2:

SEMANA No.	MEXICO 2020	PERU	ECUADOR 2021	BRASIL	GUATEMALA 2021	TOTAL
1	29734	2,201,213	103,382	0	0	2334329
2	143502	2,486,555	40,449	0	0	2670506
3	305963	3,668,688	0	0	0	3974651
4	559336	3,057,240	0	0	0	3616576
5	724363	0	0	0	0	724363
6	685695	0	0	0	0	685695
7	829283	0	0	0	0	829283
8	713428	0	0	0	5,600	719028
9	1046730	0	0	0	44,643	1091373
10	1356592	0	0	0	64,993	1421585
11	1570133	0	0	0	165,957	1736090
12	1775449	0	0	0	322,714	2098163
13	2052015	0	0	0	392,547	2444562
14	1847177	0	0	0	494,606	2341783
15	2825365	0	0	0	713,888	3539253
16	2882540	0	0	0	740,536	3623076
17	2885060	0	0	0	514,593	3399653
18	2203872	0	0	0	302,109	2505981
19	2429475	0	0	0	143,191	2572666
20	2428610	0	0	0	0	2428610
21	2507985	0	0	0	0	2507985
22	3059000	0	0	0	0	3059000
23	3603422	0	0	0	0	3603422
24	4147845	0	0	0	0	4147845
25	4133816	0	0	0	0	4133816
26	3804222	0	0	0	0	3804222
27	3339255	0	0	0	0	3339255
28	3190253	0	0	0	0	3190253
29	3540965	0	0	0	0	3540965
30	3496888	0	0	0	0	3496888
31	3415708	0	0	0	0	3415708
32	3249068	0	0	73,808	0	3322876
33	2905305	0	0	254,546	0	3159851
34	2556996	0	0	501,214	0	3058210
35	2162347	0	0	626,655	0	2789002
36	1818021	0	0	771,109	0	2589130
37	1408100	0	0	879,774	0	2287874
38	955204	0	71,216	1,070,445	0	2096865
39	473942	0	152,056	1,080,124	0	1706122
40	167409	0	312,178	1,091,698	0	1571285
41	0	0	424,411	22,456	0	446867
42	0	0	944,596	2,001,674	0	2946270
43	0	0	1,274,623	875,216	0	2149839
44	0	0	1,536,142	738,363	0	2274505
45	0	0	1,234,033	341,663	0	1575696
46	0	50954	1,552,882	403,171	0	2007007
47	0	81526	1,380,701	342,125	0	1804352
48	0	407632	1,184,447	302,944	0	1895023
49	0	886599	780,962	115,752	0	1783313
50	0	1477666	725,991	151,267	0	2354924
51	0	1885298	342,368	95,256	0	2322922
52	0	2517128	189,791	0	0	2706919
TOTAL	**83230073**	**18,720,499**	**12250228**	**11,739,260**	**3905377**	**129845437**
%	**64.099344**	**14**	**9.4344694**	**9**	**3.0077122**	**100**

6.3 FREE TRADE AGREEMENT AND PHYTOSANITARY MEASURES

Mexico, Guatemala, Peru, Ecuador, and Brazil are signatories to the World Trade Organization (WTO) and, as such must ensure the appropriate application of phytosanitary measures in international trade.

The Food and Agriculture Organization of the United Nations (FAO), has developed more than 37 international standards on phytosanitary management (ISPM) through the International Phytosanitary Protection Commission (IPPC) in support of the development of international trade, the most important of which are the following:

Requirements for the establishment of pest free areas **(ISPM 4, v.2017)**; Glossary of phytosanitary terms **(ISPM 5, v.2020)**; Determination of the status of a pest in an area **(ISPM 8, v.2017)**; Guidelines for pest eradication programs **(ISPM 9)**; Requirements for the establishment of pest free production locations and sites **(ISPM 10, v.2016)**; Application of integrated measures with a system approach to pest risk management **(ISPM 14, v.2019)**; Requirements for the establishment of low pest prevalence areas **(ISPM 22)**; Establishment of pest free areas for fruit flies (Tephritidae) **(ISPM 26, v.2020)**; Recognition of pest free and low pest prevalence areas **(ISPM 29)**; Establishment of low pest prevalence areas for fruit flies (Tephritidae) **(ISPM 30)**; Determination of the status of a fruit as a host for fruit flies **(ISPM 37).**

Additionally, reference is made to the Guidelines for the Establishment, Maintenance, and Verification of Fruit Fly Free Areas in North America – NAPPO **(ISPM 17, v.2019)**

This, despite the fact that in May 2019 a group of experts (GE) unanimously agreed to archive ISPM 17. Members of the three member countries of the NAPPO considered that the IPPC had adopted newer and more comprehensive standards that could contribute information and effectively replace ISPM 17. The more pertinent of these standards is ISPM 26 –Establishment of Fruit Fly Free Areas (Tephritidae). The official communications from the three member countries of the NAPPO confirmed that the quarantine actions currently reference ISPM 26, instead of ISPM 17. Moreover, the Capacity Application and Development Committee (CADC) of the IPPC recently published a set of guidelines for the establishment and maintenance of pest free areas.

Each one of the five countries must undertake a diagnostic to determine how far their respective national legislations have progressed with respect to the International Standards for Phytosanitary Management (ISPM) currently in effect, and applicable to the establishment, declaration, and recognition of fruit fly free areas.

7. CURRENT STATUS

More than 90% of the mangos imported to the US each year, which according to the export program for 2020 is equivalent to 520,000 metric tons, is sourced from the countries of Mexico, Peru, Brazil, Ecuador, and Guatemala.

Mexico currently exports approximately 69,000 metric tons to the US without the application of the hot water treatment (approximately 20% of the total volume exported from Mexico to the US), from a mango production area of 5,680 ha officially declared and recognized by the USDA as a fruit fly free area, located primarily in the State of Sinaloa in northern Mexico.

Mexican mangos not subject to the hot water treatment supply retail stores in the US during weeks 24 to 40 (May to September).

Peru, the second largest exporter of mangos to the US, with an annual volume of 75,000 metric tons, has issued an official report from MINAGRI (Ministry of Agriculture and Irrigation) that, beginning in the year 2023, the country can be declared fruit fly free, which includes approximately 32,000 ha currently planted with mangos for export.

Peruvian mangos not subject to the hot water treatment protocol could supply US retailers during weeks 46 to 8 (November to February).

8. OPERATIONAL STRATEGY

Based on International Standards for Phytosanitary Management (ISPM) 26 and 29, referring to the establishment, declaration, and recognition of fruit fly free areas, a general operational strategy must be implemented that includes the following components:

8.1 Territorial Organization

With the support of the Secretariats and Ministries of Agriculture (MAGA), specifically the Departments of Promotion and Development of Fruit Farming (DEFRUTA), General Offices for Plant Health, MOSCAMED and MOSCAFRUT Programs, Exporter Association Mango Committees, and mango producer associations, the list of mango production and export locations and sites that ship product to the US will be updated.

Based on the mango production locations and farms in the States, Departments, and Municipalities, a determination will be made of the 90,000 ha of mango plantations with the greatest potential for the establishment, declaration, and recognition as fruit fly free areas.

In these zones, a determination will be made of their fruit fly pest status (ISPM 8).

In each one of these mango production farms or sites, a determination will be made of the number of species of fruit flies that are present, the surface area of neighboring commercial farms that grow fruit fly host crops, the characteristics of the neighboring areas with plants that include secondary, alternating, or potential host fruits for pests, and the geographical distribution and infestation levels (seasonal abundance) of the fruit flies that are present.

This territorial organization will consider the work areas currently established by MOSCAMED and MOSCAFRUT.

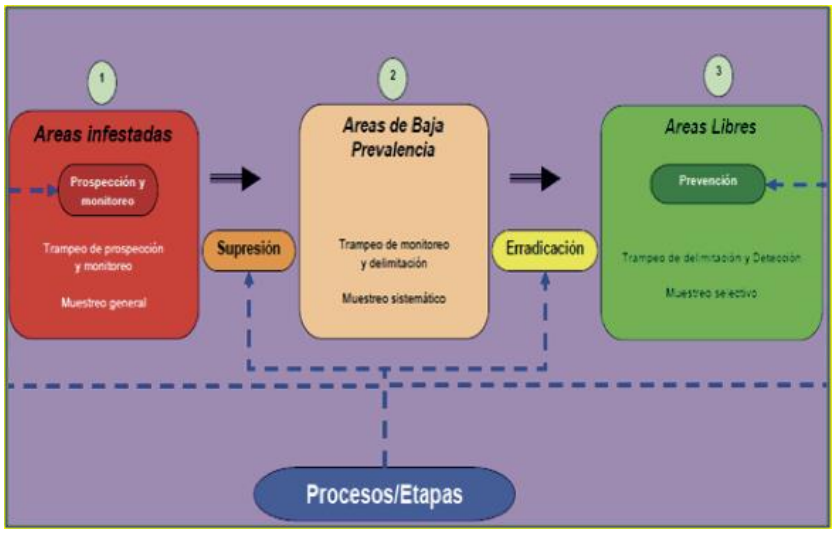
The ALMA-MANGO strategic plan is conceived as an articulating plan that integrates the institutional and operational strengths of MOSCAFRUT and MOSCAMED within the fruit fly framework and executes the actions in the locations and sites identified as those with the greatest potential for the establishment of fruit fly free areas.

8.2 Categories for the Integrated Management of Fruit Flies

With the information obtained through trapping and sampling of the pest distribution and the seasonal levels of fruit fly infestation, a control stage will be conducted, followed by a suppression stage, and ending with an eradication stage.

For the purpose of harmonizing the criteria, the ALMA-MANGO project farms will be classified based on 5 categories, stages, or management processes (Refer to Figure 1):

FIG. 1: Stages of the process involved in the establishment of pest free areas.



a) Infested Area (Area E).

Possesses soil and weather conditions suitable for the development of primary and secondary hosts for fruit flies.

It's an area in which only monitoring actions are executed, using detection with traps, for the purpose of understanding the behavior of the natural populational levels of the pest, which

allows for the appropriate decision-making in response to a higher or lower pressure caused by natural fluctuations of the pest.

This situation is observed more frequently in subtropical regions where an elevated number of farmed and non-farmed hosts bear fruit during the entire year, and the fruit fly populations are high.

The values of fertile FTD (Flies per trap per day) are greater than 1.

b) Suppression Area (D)

This area is where outbreaks and detections are recorded for the pest, in a recurring fashion throughout the course of the year, and pest control actions are conducted to suppress the values of fertile FTD until values drop below 0.1

c) Low Prevalence (C)

An area in which the pest is present at low levels, with a fertile FTD below 0.01.

Semi-arid areas along the dry corridor in the eastern region of the country are included, as well as those in the Pacific coast area, where commercial fruits are established in various spots, with few alternating hosts and limited fruit fly populations.

Likewise, consideration is given to the vast areas in the high plains with deciduous host crops, where fruit fly populations exhibit few generations per year, that have limited abundance and distribution of commercial hosts.

d) Eradication Area (B)

An area where the pest is present at low levels, with a fertile FTD value below 0.01, and subject to effective monitoring, control, and eradication measures.

e) Free Area (A)

In this surface area there is no established presence observed for fruit flies, the FTD value is zero.

Each one of the stages gives its name to the area in which it is carried out, which is how we know the areas of infestation, control or suppression, low prevalence, eradication, and free. In each one, the eradication activities are applied to a degree that ranges from lowest to greatest until the objective of establishing fruit fly free areas is met.

8.3 Development and application of the protocols that regulate the classification of areas, as well as the techniques related to the integrated management of fruit flies.

Reference the international standards, developed by the FAO and the International Phytosanitary Protection Convention (IPPC), since all five countries are signatories to the World Trade Organization (WTO).

In particular, the National Phytosanitary Protection Organization (NPPO), that normally answers to the General Office of Plant Health of the Secretariats and Ministries of Agriculture, must develop the corresponding standards to establish and declare fruit fly free areas.

8.4 Participation of Mango Producers and Exporters Associations, as well as Civil Society Stakeholders.

Within the framework of a public-private partnership, as well as institutional agreements, Exporter Association Mango Committees will engage in direct communication with the populations that have settled in the fruit fly monitoring, control, and eradication zones and, aided by the existing fruit growers associations in the area, proceed to undertake the respective monitoring, control, and eradication actions, obviously within the framework of the technical protocols approved by the NPPO based on the national and international standards that are in effect.

What this pertains to, is that owners of farms, orchards and parcels, in addition to authorizing the execution of MOSCAMED and MOSCAFRUT activities on their properties, will themselves, with the coordination and technical support from MOSCAFRUT and MOSCAMED, undertake the execution of the control actions, namely: Chemical Control by Land, Chemical Control by Air, Mechanical Control, Autocidal Control by Land, Autocidal Control by Air, for which bilateral agreements will be entered into between the Ministries and Secretariats of Agriculture and Exporter Association Mango Committees. These technical and financial agreements will constitute the legal authority for the execution of the ALMA-MANGO Strategic Plan.

THIS WILL ALLOW A DEEPER SENSE OF BELONGING FOR THE MANGO PRODUCERS AND EXPORTERS, BECOMING ALLIES AND DIRECT BENEFICIARIES OF THE ACTIONS OF THE MISCAFRUT PROGRAMS.

9. EXECUTION AND COORDINATION MECHANISMS

The legal authority for the execution and coordination mechanisms of the ALMA-MANGO Strategic Plan is the existence of a technical and financial cooperation agreement entered into and signed between the Ministries of Agriculture and the Exporter Associations.

Additionally, the Ministries of Agriculture, based on their functions and attributions, delegate to the Exporter Associations the fruit fly detection, control, and eradication actions, as well as the establishment of fruit fly free areas in mango production and export zones that ship product to the US (Refer to Figure 2)

FIG. 2: Coordination and execution mechanisms.

TABLE 3:

No.	ACTIVIDAD	MINISTERIOS DE AGRICULTURA	GREMIALES DE EXPORTADORES
1	DETECCIÓN		
	a) Trampeo	XXXXX	
	b) Muestreo	XXXXX	
	c) Laboratorio identificación	XXXXX	
2	CONTROL Y ERRADICACIÓN		
	2.1 Químico		xxxxx
	2.2 Mecánico		xxxxx
	2.3 Cuarentenario	xxxxx	xxxxx
	2.4 Autocida	xxxxx	
	2.5 Biológico	xxxxx	
3	DECLARATORIA AREA Y HUERTOS LIBRES (Mango)	xxxxx	
4	Elaboración Dossier para Reconocimiento por USDA de Areas y huertos Libres.	xxxxxx	xxxxxx
5	Mantenimiento de Areas Libres	xxxxx	xxxxx
6	Investigación y desarrollo de Métodos		xxxxx
7	Elaboración de Protocolos de Huertos Libres MOSCAS de la Fruta	xxxxx	xxxxx
8	Divulgación y Transferencia de Tecnología	xxxxx	xxxxx
9	Dirección ALMF-MANGO	xxxxx	xxxxx
10	Administración Proyecto		xxxxx

Said cooperation agreement must contain a clear indication of the functions and participation of the governments through the Secretariats and Ministries of Agriculture.

Table 3 shows a general overview of the basis for cooperation between Ministries of Agriculture and Exporter Associations.

10. AREAS OF WORK

In essence, the ALMA-MANGO Strategic Plan translates into an entity that serves as supervisor, coordinator, and harmonizer of the efforts directed at the issues related to fruit fly prevention, control, and eradication being undertaken at the present time in each one of the countries of Mexico, Guatemala, Ecuador, Peru and Brazil (MOSCAFRUT, MOSCAMED), with a clear strategic vision that the health platform must be intimately linked to the markets and knowledge platform, in order to strengthen the productivity and competitiveness of mango production areas that export product to the US.

In this sense, ALMA-MANGO will prioritize mango production and export areas that are located in areas that are officially declared by the Ministries of Agriculture as Mediterranean fruit fly free.

Subsequently, those mango production and export sites and locations, for which fruit fly monitoring information is already recorded, will strengthen control and eradication actions to ensure the eventual declaration of those sites and locations as fruit fly free areas.

In total, it is estimated that an additional 30,000 ha of mango production and export areas that ship product to the US will obtain coverage under this plan during the first 5-year stage.

Table 4 shows the geographical distribution of the work areas.

TABLE 4:

No.	PAIS	AREA TOTAL (HAS)	5 AÑOS (2022-2026) / FASE 1	5 AÑOS (2027-2031) / FASE 2	5 AÑOS (2032-2036) / FASE 3
1	México	25,000	5,000	10,000	10,000
2	Guatemala	5,000	5,000	0	0
3	Ecuador	5,000	5,000	0	0
4	Peru	30,000	10,000	10,000	10,000
5	Brasil	25,000	5,000	10,000	10,000
	TOTAL	**90,000**	**30,000**	**30,000**	**30,000**

11. STRUCTURAL COMPONENTS

The ALMA-MANGO Strategic Plan contains the structural components based on the International Standards for Phytosanitary Management (ISPM) and the Ministerial Agreements issued by the respective Ministries and Secretariats of Agriculture.

Table 5 shows a summary of these components.

TABLE 5:

Structural components

GENERAL AND SPECIFIC REQUIREMENTS FOR THE ESTABLISHMENT OF A FRUIT FLY FREE AREA

No.	COMPONENTE (Requisito)	ACTIVIDADES (Especificaciones)
I.	CARACTERIZACIÓN DEL AREA	1.1 Delimitación del Área a) Mapas Detallados b) Fronteras c) Barreras Naturales d) Zonas Tampón, etc
		1.2 Clima (Precipitación, Humedad Relativa, Temperatura, Velocidad y dirección del viento.
		1.3 Historial de la Plaga (Banco de datos de detección de la plaga, mínimo un año)
		1.4 Mapas de Rutas (Monitoreo y listado de frutos hospederos de la plaga/tecnología)
		1.5 Estudios Continúos (Monitoreos para detectar en forma oportuna la plaga).
II.	ESTABLECIMIENTO AREAS LIBRES DE MOSCAS DE LA FRUTA (ALMF-MANGO)	2.1 Delimitación ALMF
		2.2 Actividades de Vigilancia para establecer ALMF.
		2.3 Medidas Fitosanitarias relacionadas a la movilización de material de hospederos
		2.4 Técnicas de supresión, y erradicación de la plaga.
III.	ZONA TAMPON	3.1 Cuando el aislamiento geográfico sea inadecuado se recomienda establecer una zona tampón para prevenir la introducción de la plaga ó reinfestación del ALMF propuesta.
IV.	ACTIVIDADES DE VIGILANCIA ANTES DEL ESTABLECIMIENTO DEL ALMF.	4.1 Procedimientos de trampeo
		4.2 Procedimientos muestreo de fruta
		4.3 Controles para la movilización de artículos reglamentados.
		4.4 Información técnica adicional
V.	DECLARATORIA NACIONAL DE AUSENCIA DE LA PLAGA	5.1 El MAGA con apoyo de Sanidad Vegetal, publica en el Diario de Centro América el reconocimiento nacional de ALMF una vez cumplidos los requisitos.
VI.	MANTENIMIENTO DEL ALMF	6.1 Fortalecer el sistema de cuarentenas internas del país. (Controles para la movilización de artículos reglamentados). 6.2 Vigilancia para el mantenimiento del ALMF (Efectuar monitoreos permanentes de la plaga complejo de moscas de la fruta). Red de trampeo para detección de adultos, y muestreo de frutos hospedantes para la detección de larvas. 6.3 Validación de tecnología para el control de las plagas. 6.4 Desarrollar programas de extensión agrícola con enfoque de hortofrutícola y de control de las plagas Moscafrut. 6.5 Acciones Correctivas Implementar planes de Contingencia o emergencia de áreas, lugares ó sitios libres de la plaga MOSCAFRUT.
VII.	SUSPENSION, RESTABLECIMIENTO Ó PERDIDA DEL ALMF.	7.1 En función de la determinación de la situación del Complejo de moscas de la fruta, se podrá determinar la suspensión, restablecimiento ó pérdida de un ALMF.

At the operational level, the following actions will be implemented:

11.1 FIELD OPERATIONS

11.1.1 DETECTION

Consists of the implementation of a fruit fly monitoring network in the determined work areas, for the purpose of protecting and ensuring the early and timely detection of fruit flies of economic importance that are not present, to undertake an emergency eradication plan to address the pest that is detected.

A trapping network will be set up based on the pest entry or infestation risk level for each mango production unit interested in exporting product to the US, as well as the EU, which will be periodically reviewed every 7 to 14 days.

11.1.1.1 TRAPPING

It's the official procedure carried out during a given period of time to determine the characteristics of a pest population, or to determine the species that are present within an area (FAO, 1990), with the basic objectives being:

a) The detection, demarcation, and monitoring of fruit flies of economic and quarantine importance in the countries that are subject to the implementation of the ALMA-MANGO Strategic Plan.

b) Verification of the absence of the pest and timely determination of the eventual entry of one of these Tephritidae into the mango production units to activate the control and eradication emergency response plan.

The monitoring for non-present flies will consist of Jackson and McPhail or Multilure traps, with Trimedlure para-pheromone in Jackson traps for the Ceratitis species, and protein (Torula tablets) in McPhail traps for Anastrepha genus species.

The density and proportion of traps will be based on risk levels, which will consider the coverage dimension of primary hosts, commercial farms and transfer farms, urban and sub-urban areas, markets, landfills, public transportation terminals, tourism centers, immigrant routes, history of the pest, and distance to the infestation fronts.

In general terms, considering only the risk areas within the proposed area, the trapping density is between 1 and 4 traps per km^2 in the sites with host availability. The inspection of the traps is conducted at a frequency of 7 to 14 days, and all the material collected is transported to the laboratory for its respective identification.

The trapping will be dynamic, depending on the phenology of the hosts in the area, and will be periodically subjected to a quality control measure. All the traps are georeferenced by the Global Positioning System (GPS) and the Geographic Information System (GIS).

11.1.1.2 SAMPLING

Sampling will consist of the collection of fruit samples and other materials that allows for the detection, geographic location, and monitoring of fruit fly populations in any state of immaturity (eggs, larvae, and pupa).

It's important that the fruit samples be preserved under the appropriate conditions to maintain the viability of all the immaturity states of the fruit flies, in infested fruit, for the purposes of the identification process (FAO, 2009 NIMF 26).

It allows for the measurement of the degree of infestation through the index number of larvae per kg of fruit sampled. The results provide the best support for control decisions.

11.1.1.3 IDENTIFICATION LABORATORY

The MOSCAFRUT and MOSCAMED programs for the countries of Mexico, Guatemala, Ecuador, Peru and Brazil have the adequate infrastructure and professional and technical staff to carry out the identification of immature, fertility, or sterility states in the case of Ceratitis capitata, as well as for the identification of other fruit fly species of economic importance.

The samples collected will be taken to the respective identification laboratories located in the different MOSCAMED and MOSCAFRUT operations centers.

11.1.2 CONTROL

The implementation of different control measures is focused on achieving, within a reasonable time frame, the eradication of fruit flies in areas where there are mango production and export operations that ship product to the US.

In this sense, to successfully apply these measures, sufficient knowledge about the ecological requirements of the various fruit fly species is needed to have the capability to combat them.

Through trapping and sampling, an adequate amount of information can be collected about the populational dynamic that would permit a better understanding of the data, such as outbreak dates, duration of the most harmful stages from the economic standpoint, and others, making it a very useful weapon to determine the season and the form of the control application. Additionally, it's important to know the preferred host for each species, as well as their daily activity habits (search for food, reproduction, natural enemies).

11.1.2.1 CHEMICAL CONTROL

By and large, based on the applications of insecticide-bait, or toxic bait, directly on the foliage, and constitutes an economic and effective alternative to fruit fly control.

When combining an insecticide with a lure, the recommendation is to make selective, not generalized, applications.

11.1.2.1.1 Chemical Control by Land

Consists of the application of food-based toxic bait, for which the use of backpacks with manual pumps with sufficient pressure to reach the tops of small trees and bushes are required.

For taller trees, a motorized stationary pump should be used that can couple a hose of at least 50 m of length to a wand that has a drop size regulation system for the product output, through various types of nozzles, pressure, and reach distance for the bait. Additionally, the equipment must have suction hoses that are appropriate for absorbing the product from a container.

In the latter case, two people will be required, one to handle the pump and the product, and the other to perform the application.

A product developed in recent years that constitutes a good alternative to the use of Malathion or some other conventional insecticide is Spinosad (Success GF-120), which is a natural prepackaged bait in concentrated form that is suitable for use on organic crops.

Spinosad is a natural insecticide derived from the metabolites of a naturally occurring bacteria called Saccharopolyspora spinosa that is commonly used for fruit fly control (Dow AgroSciences, 2001).

11.1.2.1.2 Aerial Chemical Control

When conditions and land dimensions allow for it, the application of toxic bait against fruit flies can be carried out using helicopters or aircraft.

11.1.2.1.3 Bait Stations

The set up will include bait wax stations, GF 120 bait stations, and mass trapping devices with enzymatic hydrolyzed protein.

Corncob lures, made of corncobs impregnated with toxic bait, can also be used. These are hung from the branches of plants with a wire.

11.1.2.2 MECHANICAL CONTROL

Consists of manual collection and destruction of fruit infested with the larvae of flies that has dropped to the ground.

The recommendation for farms is to dig 1.5m x 2 m holes, 1 m deep, where the fallen fruit can be deposited and a layer of dirt of approximately 30 cm can be spread on top, after which lime can be used to cover the area and eliminate the possibility of any adult fruit flies escaping from the hole.

11.1.2.3 AUTOCIDAL CONTROL

When chemical and mechanical controls have resulted in the reduction of FTD populations below 0.01, applications can begin via land or air of large quantities of sterile males with which fruit fly eradication can be achieved.

11.1.2.4 LEGAL OR QUARANTINE CONTROL

Defined as the development, approval, and application of a set of laws, standards, regulations, and procedures with the purpose of avoiding the propagation or introduction of pests (insects, fungi, viruses, weeds, etc.) through the movement of infested plant products towards areas or countries where they are not present.

12. BUDGET AND FINANCING

The estimated budget for the ALMA-MANGO Strategic Plan, which implies the implementation of fruit fly control and eradication activities in areas with great potential for the establishment and declaration of fruit fly free areas, is an average of $300/hectare/year.

Taking into account an area of 30,000 ha, the annual cost to operate the strategic plan is US$9 million.

In terms of financing, the recommendation is to undertake a collaboration, that is, a public-private partnership, subscribing to the corresponding technical and financial support bilateral agreement between ministries of agriculture and exporter associations.

Subsequently, through ALMA-MANGO, cooperation agreements can be made with other countries and international organizations to continue with the financial support of monitoring and control actions for declared Mediterranean and other fruit fly free areas in mango production and export zones that ship product to the US.

13. TIMELINE

The strategic plan proposes an execution over the course of three five-year phases and each phase will involve 30,000 ha.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