Chapter

Main Pests and Diseases in Tropical Forest Species in Nursery

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Abstract

This paper presents the monitoring of pests and diseases in nurseries of 10 tropical forest species used in the reforestation of disturbed areas. The work was carried out in a rustic nursery established in Cardenas, Tabasco, under cocoa shade. The objective was to evaluate the presence of pests or diseases in the nursery under natural conditions. Pests and diseases appeared from the seedling stage in germination beds to the adult stage. The fungus *Fusarium* was the most aggressive causal agent that caused the death of seedling in the germination beds, as well as *Curvularia lanata* that massively affected *Tabebuia rosea* plants. Likewise, *T. rosea* is one of the species with the most reported pests, as well as *Lantana camara*. On the contrary, *Hamelia patens* Jacq (Coralillo) did not registered important pests during the monitoring in the nursery.

Keywords: tropical foest species, pests, diseases, nursery, plants

1. Introduction

In the tropics, the diversity of plant species is very high, although the species richness is not so great because they share the habitat with the other biological forms of that environment, such as shrubs, vines, lianas, parasitic epiphytes and palms.

In Mexico, for a long time precious woods such as cedar (*Cedrela odorala* L.), mahogany (*Swietenia macrophylla* King.), spring (*Cybistab Donnell-Smith*) and red (*Haematoxylum campechianum* L.) were exploited to take them to other continents for various cabinetry work, to the extent that the ecosystems of the Mexican tropics were impoverished by an extraction of eugenic type, that is, taking advantage of the best quality trees with straight stems and larger diameters.

This extraction in some cases has caused the disappearance of habitats due to extractive recurrence, thus favoring that the trees do not reach their physiological maturity, although their reproductive maturity does.

On the other hand, the establishment of exotic forest plantations such as teak (*Tectona grandis* L.f.), rubber (*Hevea brasiliensis* [Willd. ex A. Juss.] Müll. Arg.), melina (*Gmelina arborea* Roxb), pine (*Pinus caribaea* Var. Hondurensis [Sénécl] W.H.G.) or eucalyptus (*Eucalyptus* sp), Oil palm (*Elaeis guineensis* Jacq.) by large corporations, has caused the reduction of the surface of the original vegetation,

because when establishing these plantations all the vegetation present is eliminate, and far from supporting the local population, it exterminates the environments of the area, leaving only pockets of impoverished land to restore part of the lost biological diversity.

In this sense, forest nurseries of local species are created in order to provide seedlings to recover the strongholds of impoverished areas, potential environments or even include other environments for conservation.

For this purpose, the availability of germplasm is an activity of transcendental importance in which the possible progenitors are located, the period of flowering and fruiting is expected and later the seed is collected. This seed is taken to the nursery, processed, sown and the emergence of the seedlings is expected. At this stage, the management and care of the seedlings is of utmost importance because they are more susceptible to attack by pests and/or disease of any pest or illness.

Under this concept, in order to generate information about the main pests of some forest species used in reforestation in a mixed way, ten germination and growth beds of various local forest species were established. It is possible that due to the difference in habitat conditions between the site where they grow naturally and the nursery conditions where they were produced, some pests and diseases were present both in germination beds and growth beds and that are reported in this work.

Currently, it is a common practice to produce forest plants in a nursery and when the seed does not come from certified seed banks, these generally already bring the pest from the harvest field in a certain percentage, which are not suitable for cultivation.

When the percentage of impurities has been eliminated, the resulting seed is sown in bags, tubes, trays or germination beds depending on the size of the seed and wait for them to germinate. During the process of germination and growth of seedlings some diseases occur.

1.1 Damping off Rizotocnia

This is a type of opportunistic fungus that occurs when excess moisture in the site is above what the plant can dispose of. This excess moisture ends up rotting the stem of the seedling. They generally call it a dryer and it is common in various species of plants in the region such as cocoite, cedar, bojon, guanacaste, to name a few species and generally what is presented is the mycelium since they rarely form structures of sexual reproduction.

This fungus is very damaging as it forms resistant structures called interconnected Sclerotia that infect the roots of newly emerging plants and can rapidly spread over much of the germination bed.

Its presence is greater in alkaline soils with poor drainage, so generally the substrate must be fumigated with methyl bromide before sowing, covered with plastic and uncovered after two days so that there is aeration, and the seed is sown after 72 hours of aeration.

Another very common fungus is Fusarium sp., and it occurs when the seed generally does not go through an antifungal treatment before sowing, so the fungus Fusarium oxysporum attacks the external and even internal structures of the seeds. The newly emerged seedlings are covered with a white mycelium that affects the new organs of the plant, which is controlled using thiabenzadol at a dose of 1 g per l of water.

2. Germoplasm collection

During the year 2020, germplasm of various forest species or species of interest for biological diversity was collected, this in order to produce plants in germination beds, these species were: *Cedrela odorata* L., *Bursera simaruba* (L.) Sarg, *Cordia megalantha* S. F. Blake, *Hamelia patens* Jacq., *Pimenta dioica* L. (Merr), *Tabebuia rosea* (Bertol) Dc, *Lantana camara* L., *Sterculia apetala* (Jacq.) H. Karsten, *Roystonea regia* (Kunth.) O. F. Cook, and *Chrysobalanus icaco* (L.) L.

The collection of fruits was carried out by various methods such as collection from the ground, collection with a pole and hand scissors, manual selection of the fruits in the branches, specifically for the fruits of the royal palm, it was necessary to climb the palm using a team of ropes to electricians. These fruits were transported in jute sacks to the nursery and the benefit was made there.

Since the palm fruits have a very hard test, they were kept in the sack for a week, then they were washed and then physical scarification was carried out to accelerate the germination.

The seeds of all species were scarified to ensure germination. Specifically, for *H. patens* Jacq (Coralillo), because seeds were collected twice and germination did not occur, cuttings of approximately 20 cm in length were collected. These were placed in a bucket with a prepared solution of rootstock in a proportion of 15 g per 5 l of water. Here the basal part of the cutting was submerged for 5 minutes and then it was planted in the bags of soil.

The substrate used for the germination beds was grit enriched with filter cake, which is a residue obtained in the cane juice clarification process, which includes earthy materials and organic impurities [1].

2.1 *Cedrela odorata* L., (red cedar)

The planted cedar germplasm was quality seed, selected and of regular size, and reached its total germination at 18 days, this presented some problems in the germination beds, mainly due to excess water and lack of drainage, which generated problems of germination and presence of *Fusarium* and *Pythium*.

In the already bagged plants, the Meliaceae borer *Hypsiphylla* grandella was present, and caused problems in 6% of the plants, which were lost due to the bored stem [2]. To avoid greater severity of the damage, sprays were applied both to the plants in bags and to the adjacent beds that were in the process of growth.

Worldwide the main pests of cedar are insects of the genera *Anacrusis* sp. (Tortricidae), *Antaeotricha ribbel* (Stenomidae), *Hypsyphylla grandella*, as well as ants of the *Atta* genus. For Costa Rica, the presence of 15 pests in cedar and two diseases caused by Fusarium Sp and *Phyllachora balansae*, in addition to the species *Orthogeomys heterodus* was reported [3].

The presence of a cedar leaf-roller worm was also recorded, the presence of this pest was recurrent at least four times in six months while the plants were in the nursery. In the substrate, a large number of blind chicken caterpillars (*Phyllopaga* sp), which are beetle larvae, were recorded, but they did not cause any damage to the cedar plants.

In some plants the mealybug (*Mastigimas* sp) appeared, covering the entire plant, which caused its weakening and death due to the overpopulation of the mealybug, these plants were eliminated. For Mexico also was reported nine species of pests for cedar [4]. The insects reported for Costa Rica and México are listed in **Tables 1** and **2** [3, 4].

Insect	Family	Affected part
Anacrusis sp	Tortricidae	Foliage
Antaeotricha ribbel	Stenomidae	Foliage
Apatelodes sp	Apatelodidae	Foliage
Atta sp	Formicidae	Foliage
Hypsypylla grandella	Pyralidae	Shoots, seeds
Mastigimas sp	Psillidae	Foliage
Natad sp	Limacodide	Foliage
Phyllocnistes meliacella	Gracilariidae	Foliage
Sematoneura atrovenosella	Piralidae	Seeds
Sematoneura grijmani	Piralidae	Seeds
Taeniopoda sp	Romaleidae	Foliage
Thecla cupentus	Lycaenidae	Foliage

Table 1.
Insects reported for red cedar in Costa Rica [3].

Specie	Common name	Distribution in Mexico
Cicadellidae	sharpshooter	Wide distribution
	mealy louse	Campeche, Jalisco, Oaxaca, Puebla Quintana Roo, Tabasco, Tamaulipas, Veracruz and Yucatán
Atta cephalotes	leafcutter ant	Campeche, Chiapas, Oaxaca, Quintana Roo, Tabasco and Veracruz
Atta mexicana	leafcutter ant	Guerrero, Jalisco, Nayarit Tamaulipas and Veracruz
Hypsypylla grandella	borer	Wide distribution
Chrysobothris	borer	Wide distribution
Nasutitemis	termites	Wide distribution
Phyllophaga	blind chicken	Wide distribution
Tetranychis	red spider	Hidalgo, Oaxaca, Puebla and Veracruz

Table 2.
Cedar pest insects reported for México [4].

2.2 T. rosea Bertol dc. (Macuilis)

Despite the fact that macuilis is one of the hardest species in the state and, in turn, one of the hardest woods, it presents a great diversity of pests and diseases in the nursery. One of the main ones that appeared was the Curvularia lanata fungus, which quickly withered a large number of plants, for which it was necessary to remove the burned leaves, apply fungicide and promote ventilation to the growth beds.

Likewise, the so-called spring rust of *Prospodium perornatum* appeared sporadically on some of the approximately five-month-old *Tabebuia rosea* Plants.

The affected part showed its spermogonia as reddish dots on deep green swollen areas; especially in the upper part of the pedicel of the leaf forming an arch. This situation caused the infected leaves to break, for this reason the plant was eliminated.

A recurring pest was the *Eulepte gastralis* worm, which was present at different stages and which caused damage to the leaves causing their skeletonization, whose protection is a mesh of silk and excrement. A large population of blind hen (*Phyllophaga* sp) was recorded in the substrate, however, since its presence was in the rainy season, it did not cause damage to the macuilis plants.

For macuilis, it has been reported that it is susceptible to attack by nematodes of the genus Meloidogyne incognita, which directly attack the root part [5]. *Eulepe Gastralis* (Lepidoptera: Pyralidade) in the nursery presents a relationship between density and stratum so that the plant is affected. Other authors report a wide diversity of pests for Mexico and the Roca coast **Table 3** [3, 4].

Pest	Family	Stage	Type of affectation
Modoryx oielus Clarke	Lepidoptera: Sphingidae	cobra worm a	eats leaves
Megalostis anacoreta L.	Coleoptera. Chysomelidae	greater hog	gnaws buds
Megistops sp	Coleoptera. Chysomelidae	Oak manakin	gnaws buds
Oiketicus kirbyi (Lands-Guilding)	Lepidoptera: Psychidae	básquet worm	eats leaves
Oncideres teddellata (Thoms)	Coleoptera:cerambycidae	spotted harlequin	pierces stems
Phobetron hipparchia Cramer	Lepidoptera Limacodidae	spider worm	eats leaves
Prosarthia teretrirostris Brunn	Ortopthera: proscopidae	flat shackle	eats leaves
Protaleura tabebuiae Dozier	Homoptera cicadellidae	leafhoppers	sucks sap
Rabdotalebra sp	Homoptera cicadellidae	leafhoppers	Sucks sap
Steirastoma hishistrionicum thams	Coleoptera:cerambycidae	harlequin engrabado	Pierce stems
Tenuipalpus sp	Acari: Tenuipalpidae	Flat mite	Sucks sap
Urodera sp	Coleoptera. Chysomelidae	humpbacked beetle	Gnaws leaves
Zygogramma cognata Stal	Coleoptera. Chysomelidae	Engraved morrocoyita	Punches sheets
Amphicerus cornutos (Pallas)	Coleoptera: Bostrichidae	Capuccino	Pierce stems
Archegozetes sp.	Oribatida: epilohmanidae	painted mite	Terminals
Atta sp	Hymenoptera:Formycidae	leafcutter ant	cut leaves
Automeris junonia	Lepidoptera. Saturniidae	spiny worm	eat leaves
Automeris sp	Lepidoptera. Saturniidae	spiny worm	eat leaves
Compsus sp	Coleoptera: Curculionidae	Little	eat leaves
Cryptotermes brevis (W.)	Isoptera: Kalotermitidae	termite	Pierce the base of the stem
Diabrotica sp	Coleoptera:Chrysomelydae	Morrocoyita	Log leavess
Dikraneura sp	Homoptera:Cicadelidae	leafhoppers	Sucks sap, hojas
Edessa leucogramma Perty	Hemiptera:Pentatomidae	Guayacan jackdaw	Sucks sap

Pest	Family	Stage	Type of affectation
Eriophyes sp.	Acarina:Eriophydae	roller	gills leaves
Eulepte gastralis guanee	Lepidotera:Pyralidae	sheet gluer	eat leaves
Gastrotrips sp.	Thysanoptera:Phlaeotripidae	black trips	Micetophage
Halisidota sp	Lepidoptera:Arctiidae	silly chapola	eats leaves
Hemeroplanes Parce F.	Lepidoptera:Sphingidae	cobra worm	eats leaves
Hyphotenemus sp	Coleptera: Solytinae	scolithid	Pierce stems
Lagochirurs araneiformis LInn	Coleoptera Cerambicidae	painted Brown harlequin	Pierce stems and brances ramas
Lepydomys sp	Lepidoptera: Pyralidae	oak borer	pierces terminals

Table 3.
Pests reported for Tabebuia rosea [3, 4].

2.3 R. regia (Kunth) O.F. Cook (Royal Palm)

This palm was very susceptible to the Fusarium fungus during the nursery stage, mainly in the pinnae of the fronds. This fungus was present after the rainy season. Causing necrosis on the sides of the pinnae and in the terminal part of the frond, which caused dieback of an entire batch of these palms in the nursery. The fungicide Captan was applied repeatedly with few positive results, although depending on the severity of the damage, the application response could be any other fungicide [6].

2.4 L. camara L.

Being a fast-growing species, it is offered as an attraction for various nursery pests. During the evaluation period in the nursery, this plant grew and flourished and in turn attracted pests such as *Tetranychus urticae* (red spider), some type of aphid and some unidentified caterpillar. Disorganized plant growth provided safe haven for these pests, however, they were not considered severe pests as they did not cause problems to the plants.

This species as an aggressive weed for livestock capable of invading agricultural areas if it is not managed properly [7]. In this regard, were reported the presence of 118 pest species, some in all stages of development [8]. In the state of Tabasco, this species is found in abandoned agricultural areas or is part of the ruderal areas, but because the agricultural surface per producer is not very extensive, every two years the land for crops is cleared, for this reason it does not extend aggressively. Some authors delimit a wide diversity of 29 species of common pests for this species, some of the most frequent are *Tetranychus urticae* spider or red spider: this spider weaves its web on the underside of the leaves, so it cannot be seen with the naked eye and feeds on the sap of the leaves [9]. This species of pest was very common in the six months of the nursery and its presence was frequent, its elimination was with chemical products.

Cochineal: The presence of this pest in Lantana plants is common [10], however; in the nursery during the evaluation period it did not appear because the cochineal occurs mostly in sunny areas and the nursery maintains an average of 80% shade.

Bemicia tabaci (whitefly) appeared as a recurring pest in the nursery, its presence was manifested since the seedlings were small; This species lays its eggs on the

underside of the leaves, so the larvae feed on the sap when they emerge. The occasions that arose caused the deaths of secondary branches of the lantana plants, most of the time the plants were pruned.

Hemiptera (aphids) were present during the entire evaluation period that they were monitored. This pest is detected in the mornings on sunny days. These feed on the plants by sucking the sap, the highest concentration of aphids were located in the tender shoots or apical buds. Among the main symptoms are very sticky leaves due to the molasses excreted by these insects. His treatment was with chemicals.

Moths, a type of grayish brown moth called *Neogalea sunia* was present, it also lays its eggs on the plant and when they hatch and grow, they feed on the foliage of the plant and then become its pollinator. It is recognized because the larvae when feeding leave evidence of eating in the form of circles, their eradication is at that stage, as they are very voracious due to their color, they are easily confused with the stem or leaves of the plant and are easily lost.

Some of the diseases reported for Lantana are *Alternaria*, which manifests itself with brown spots on the leaves, in addition to Fusarium, which was very aggressive in the nursery, since it caused the decay of the plant, since it was necessary to apply antifungals, avoid irrigation and encourage the entry of sunlight.

2.5 B. simaruba (L.) Sarg

This species, despite being a rough species and well adapted to tropical conditions, presented some species of pest insects; however, the damages were not severe and did not represent damage per se to the plants in the nursery.

It was detected that the insects do not use the mulatto plants as a habitat, rather as occasional visitors, that when the plant is monitored, they quickly disappear by flying.

Some especies of pests for palo mulato, such as the beetles *Xyleborus* spp. and *Platypus* spp., as pests of green wood, *Lagochirus araneiformis* L. and other insects bore into the bark and wood, they also feed on wood and living seedling trees and Lyctus spp. attacks dry wood like termites [11].

On the other hand, despite the toughness of the plant, the *Fusarium* fungus caused serious problems in entire batches of plants because the substrate used retained a lot of moisture, also when the plant was transplanted from the germination bed to plastic containers., there was high mortality caused by Fusarium. This species tolerates abundant irrigation well, but with good filtration and 60% on shade.

2.6 *Cordia megalantha* S. F. Blake (Candelestick)

This species, at the level of plants in germination beds and bagged, did not present serious problems, occasionally some circular insect bites were observed in the dry season of the year.

However, in sowing the germination bed in the bag, mortality was very high due to the presence of Fusarium, which also occurred in royal palm and other species, due to stem, rot.

It was observed that its growth is limited when shade exceeds 65% and in turn favors the arrival of occasional insects that feed on new shoots. Likewise, when the incidence of sunlight exceeds 60%, the leaves turn yellowish and slow down their growth.

2.7 S. apetala (Jacq.) H. Karsten

In the nursery stage, important pests were observed, except that the lack of irrigation caused the plants to decay and lose their turgor. The larval phase of Micromartinia mnemusalis has been reported as a pest of S. apetala for Costa Rica [10].

The adult stage corresponds to various moths considered as pests for various species of commercial interest, however, during the monitoring phase in the nursery it was not present. This plant species was one of the least affected by pests or diseases.

2.8 Pimienta dioica L.

Pepper is a species of great interest in food and for the extraction of various oils. In some states of the republic it is not cultivated in plantations, but as shade species of other crops, such is the case of cocoa in Tabasco, or borders in pastures. Although it does not receive management, its production is considered good.

Pepper seedling age, it generally does not present pests or diseases, but it is very demanding in relation to well-drained soils and sufficient humidity, it grows well in any type of soil, from very fertile to very poor such as arenosols and savannah soils.

In the nursery and in newly established plantations, this fungus has the greatest impact. Infections present as isolated necrotic lesions that vary in size from light brown to almost black in color and may cause plant death. When the damage is severe, a yellow powder is generated on the underside of the leaf and when the inflorescences are affected, they turn black and finally die. Control could be carried out by spraying an antifungal [12].

2.9 H. patens Jacq (Coralillo)

It is a bushy species, abundant in the region, with a wide distribution from Florida to Argentina, and it is difficult to propagate by seeds. In the nursery, the seeds take up to eight months to germinate and their initial growth is too slow, so it was decided to reproduce them by cuttings. The most appropriate thickness for reproduction was one cm in diameter on average.

The cut to chop the stakes must be clean and each stake must not exceed 20 cm in length. When the cut is not clean, the bark is mistreated and that is where the rot caused by *Fusarium* begins.

This species is not of commercial importance, but it is of local use. In cultivated areas, its growth is allowed, as it attracts pests in agricultural crops. It is attracting pollinating bees, hummingbirds and butterflies. There were no pests in the nursery during the evaluation period.

2.10 C. icaco (L.) L. (Icaco)

For the establishment of the germination beds of Icaco, the seeds were first collected from the ground and later the fruits of the tree were collected.

The seeds collected from the ground were perforated by some unidentified insect, therefore, there was no germination.

Subsequently, ripe fruits were collected and put to ferment for three days in a plastic bag with the mouth closed, then the pulp was removed, the seed was washed and a physical scarification was performed, under this method germination was obtained at 28 days.

During the germination phase, there were problems with fungi that caused the death of some plants. After transplanting to the bags, the *Fusarium* fungus was also present, causing the death of some plants, and the *Curvularia* sp. fungus was frequent, causing the death of some of the terminal leaves of the plants. For this species it was reported the presence of the diptera *Anastrepha* (flies), as well as *Ceratitis capitata* and *thephytophagous* mite and *Oligonychus bagdasariani* [13].

Other authors report the presence of the Red Spider Tetranychus urticae, which causes yellowing of the leaves at the site of the bites and when it comes to attacking fruits, they acquire a dirty color due to the dark spots of the bites.

3. Conclusion

The presence of pests and diseases in the seedling stage was common. In the germination beds, Fusarium behaved recurrently in most of the germination beds, mainly in *C. odorata* and *R. regia*. The most specific pests *were Hypsiphylla grandella* for *cedrela odorata*, the fungus *Curvularia lanata* for T. rosea, as well as *Prospodium perornatum* for the same species.

Excess shade, continuous irrigation, residual moisture and evapotranspiration were key factors of importance for the development of fungi almost during the six months of monitoring of the plants in the nursery, although shade was removed from the nursery trees twice this year. it reappeared in a short time.

The pests entered the nursery in the area where the nursery adjoins herbaceous and shrubby vegetation, that is, the natural habitat of these organisms is that type of environment. It was recorded that the more the plants grow, the greater the possibility of shelter for pests.

The reason for including shrubby species such as Icaco, or herbaceous species such as lantana and Hamelia, is that in disturbed areas, herbaceous plants are the pioneers of secondary succession, and when reforestation or restoration areas are established, herbaceous species are very important for maintaining soil cover and protection. In addition, they are very important in attracting beneficial insects for Pollination.

Due to the abuse of agrochemicals for various uses, biological diversity (Flora and fauna) has been greatly reduced, so it is necessary to restore ecological conditions and habitats to generate a status of ecological balance at various scales in time. Hence, it is very important to know the pests or diseases that could affect the species used in habitat restoration.

In any environment that has been altered, pests settle in the islands of vegetation present, so their eradication is almost impossible due to their qualities of adaptation to the changing environment.

In this way, the species that are planted will have different functions over time in which the ecosystem normalizes and the insect pests adapt to that environment.

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References

[1] Hernández MGI, Salgado GS, LDJ P, Del ELC L, Castelán EM, Ruiz RO. Vinaza y composta de cachaza como fuente de nutrientes en caña de azúcar en un gleysol mólico de Chiapas, Mexico. Interciencia. 2008;**33**(11):855-860. Available from: http://ve.scielo.org/scielo.php?script=sci_arttext&pid=S0378-84420080011000016&lng=es&tlng=es

[2] Ramírez-García C, Vera-Castillo G, Carrillo-Anzures F, Octavio Salvador Magaña Y, Torres OS. El cedro rojo (*Cedrela odorata* L.) como alternativa de reconversión de terrenos agrícolas en el sur de Tamaulipas. Rev. Tec. Mex. 2008;**34**:243-250

[3] Arguedas-Gamboa M. Plagas y enfermedades forestales en Costa Rica. vol. **4**(11-12). Kurú: Instituto Tecnológico de Costa Rica, Revista Forestal de Costa Rica; 2007. p. 77

[4] Cibrian TD. Manual para la identificación y manejo de plagas en plantaciones forestales comerciales. Comisión Nacional Forestal. Universidad Autónoma Chapingo; 2013. p. 238

[5] Hernández R. F Y Briceño VA. Factores bióticos y abióticos que favorecen el desarrollo de Eulepte gastralis, en vivero de apamate. Universidad de Los Andes, Facultad de Ciencias Forestales y Ambientales. Centro de Estudios Forestales y Ambientales de Postgrado. Mérida-Venezuela Rev. Forest. Venez. 1998;**42**(2):157-166

[6] Tahir BR, Shakeel Q, Muhammad R, Rashid I. Fungal diseases of royal palm (Roystonea regia). In: Etiology and Integrated Management of Economically Fungal Diseases of Ornamental Palms. Springer Nature; 2020. pp. 222-235

[7] Matienzo Y, Ramos B, Rijo E. Revisión bibliográfica sobre Lantana camara L. una amenaza para la ganadería. Fitosanidad. vol. 7(4). Instituto de Investigaciones de Sanidad Vegetal, La habana; 2003

[8] Palmer WA, Pullen KR. The phytophagous arthropods associated with Lantana camara, L. irsuta, L. urticifolia and L. urticoides (Verbenaceae) in North America. Biological Control. 1995;**5**:54-72

[9] Vargas BB, Yoannia Gretel PBY, Fajardo R, Puertas LAA, Rizó MM. Diversidad de Insectos asociada a Lantana Camara L. (rompe camisa) en localidades agrícolas de Santiago de Cuba, Cuba. Investigación y Saberes. 2015;**Vol, IV, No. 1**(2015):17-28

[10] Cantillana E. Micromartinia mnemusalis. 2019. Available from: https://www.acguanacaste.ac.cr/paginas-de-especies/insectos/296-crambidae/4633-i-micromartinia-mnemusalis-i-crambidae

[11] Francis JK. Bursera Simaruba (L.) Sarg Burseracea. Bursera Family. 1990. Available from: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.fs.fed.us/global/iitf/pubs/sm_iitf035%20%20(5).pdf, p. 5

[12] Martínez PM, Hernández G, Martínez G. La Pimineta Gorda en Mexico (Pimenta dioica L. Merril): Avances y retos en la gestion de la iNnovacion. Coleccion Tropico Humedo. Universdad Autonoma Chapingo; 2013. p. 73

[13] Quirós de GM, Viloria Z. Tetranychus Urticae KOCH y Oligonychus Bagdasariani Baker y Pritchard, (ACARI: TETRANYCHIDAE) Acaros. 1991. En línea: https://www.intagri.com/articulos/frutales/el-caco-como-cultivo-potencial