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Original article

Associated vegetation and harmful organisms in Acacia mangium plantations Willd, in the municipality of Abreus Cienfuegos

Vegetación asociada y organismos nocivos en plantaciones de Acacia mangium Willd, en el municipio Abreus Cienfuegos

Vegetação associada e organismos prejudiciais nas plantações de Acacia mangium Willd, no município de Abreus Cienfuegos

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ABSTRACT

The inventory was carried out in *Acacia mangium forest plantations, belonging to the* Abreus Base Business Silvicultural Unit, subordinate to the Cienfuegos Agroforestry Group, during the period from January 2010 to December 2021. With the aim of identifying associated vegetation and harmful organisms (insects and diseases) in *A. mangium plantations*. The direct sampling method was used, starting with the survey of 20 plots of

10 x 10 (100 m²), within these zig-zag transects were made randomly; to collect the information, 30 samples were taken at a monthly frequency. In the inventory, 18 species were identified throughout the study area, including: *Dichrostachys cinerea, Acacia farnesiana , Mimosa pigra and Sorghum* halepense with invasive characteristics in *A. mangium* plantations . In the study, 14 species of insects were identified, of which *Paratrechina longicornis* (83.3%) *Alagonasa decemgittata* (76 %) *Attas insularis* (73 %) *and Brevipalpus sp,* (70.6%), *and Colletotrichum* diseases *gloeosporoides* (86 %) *and Uredo hymineae* (80 %), which also showed a frequency of appearance.

Keywords: diseases, Inventory, Insects, Associated vegetation.

RESUMEN

El inventario se realizó en plantaciones forestales de *Acacia mangium*, perteneciente a la Unidad Silvícola Empresarial de Base Abreus, subordinada al Grupo Agroforestal Cienfuegos, durante el periodo comprendido enero de 2010 a diciembre de 2021. Con el objetivo identificar la vegetación asociada y los organismos nocivos (insectos y enfermedades) en plantaciones de *A. mangium.* Se utilizó el método de muestreo directo, a partir del levantamiento de 20 parcelas de 10 x 10 (100 m²), dentro de estas se realizaron transeptos en zig-zag en forma aleatoria, para la toma de la información se realizaron 30 muestreos con una frecuencia mensual. En el inventario, se identificaron 18 especies en toda el área de estudio, entre ellas: *Dichrostachys cinerea, Acacia farnesiana, Mimosa pigra y Sorghum* halepense con características invasoras en las plantaciones de *A . mangium.* En el estudio se identificaron 14 especies de insectos de los cuales *Paratrechina longicornis* (83.3 %) *Alagonasa decemgittata* (76 %) *Attas insularis* (73 %) *y Brevipalpus sp,* (70,6 %), y las enfermedades *Colletotrichum gloeosporoides* (86 %) *y Uredo hymineae* (80%), que mostraron también una frecuencia de aparición.

Palabras clave: Enfermedades, Inventario, Insectos, Vegetación asociada.

RESUMO

O inventário foi realizado em plantações florestais de Acacia mangium, pertencentes à Unidade Empresarial Florestal Base Abreus, subordinada ao Grupo Agroflorestal Cienfuegos, durante o período de janeiro de 2010 a dezembro de 2021. Com o objetivo de identificar a vegetação associada e organismos nocivos (insetos). e doenças) em plantações de A. mangium. Foi utilizado o método de amostragem direta, a partir do levantamento de 20 parcelas de 10 x 10 (100 m²), dentro destas foram feitos transeptos em zigue-zague aleatoriamente, para coleta das informações foram realizadas 30 amostragens com frequência mensal. inventário, foram identificadas 18 espécies de vegetação associada, pertencentes a oito famílias botânicas, destacando-se a presença ao longo do estudo de: Dichrostachys cinerea, Acacia farnesiana, Mimosa pigra e Sorghum halepense como vegetação invasora nas áreas de plantio do TO. mangium No estudo foram apresentadas 14 espécies de insetos, das quais Paratrechina longicornis (83,3 %), Alagonasa decemgittata (76 %), Attas insularis (73 %) e Brevipalpus sp, (70,6 %), tiveram a maior frequência de aparecimento. e 11 doenças onde Colletotrichum gloeosporoides (86 %) e Uredo hymineae (80 %) apresentaram maior frequência de aparecimento.

Palavras-chave: Doenças, Inventário, Insetos, Vegetação associada.

INTRODUCTION

Acacia is a term that comes from the Latin acacia, although its etymological root is found in the Greek language; its name comes from the Greek akakia, derived from ake, akis, which means tip or thorn, which refers to the thorns of the acacias. American and African (Ramos-Díaz, *et al* 2020).

Acacia genus is accompanied by more than 1,300 species, which are naturally distributed on all continents except Europe; more than 900 of these are native to Australia and the rest to the dry and temperate tropical regions of Africa, Asia and America; Reyes *et al.* (2018). It is suggested that it is possible to find *Acacia mangium plantations in almost all tropical and subtropical areas of the planet. Its distribution thrives under a wide variety of sites,* its species provide multiple wood, non-wood, environmental and ecological products and services, in the areas of origin and in other regions where they have been introduced (Reyes *et al.* 2018)

Acacia mangium can reach tree or shrub size, belongs to the Fabaceae family and the Mimosaceae subfamily. This species is widely distributed in the peninsula northeast of Australia, south of New Guinea and Western Iran. It occurs discontinuously forming small stands in the Moluccas Islands. It has been introduced in Bangladesh, Cameroon, Costa Rica, Colombia, Hawaii, Indonesia, Malaysia, India, Nepal, Papua New Guinea, Vietnam and the Philippines, and naturalized in Puerto Rico, Brazil and Cuba (Reyes *et al*. 2018).

It is a species recently introduced in Cuba to promote plantations; it is among the main species included in the reforestation plans until 2023. In 2009 it was introduced in the Abreus municipality, Cienfuegos province, where 4.1 ha were planted mainly in areas of flat relief throughout Bolívar Avenue, since that date and until 2021, 439.9 ha have been planted, without knowing the pests present in these agroecosystems (ETPP 2024).

The forest agroecosystems of *A. mangium in the* Abreus municipality are of great interest to the economy due to the importance of their production. These constitute one of the most complex natural landscape units in terms of function, structure and dynamics, from the maintenance, care and improvement of forest areas. However, there are few studies that address the phytosanitary problems that affect these productive systems, information that was offered by the experts of the Caunao Territorial Plant Protection Station (ETPP 2024), of the Cienfuegos province; who by common agreement expressed the need to seek new alternatives for the phytosanitary protection and conservation of the species in this agro-productive scenario , where it is necessary to carry out pest inventories in the specific conditions in the Abreus municipality, Cienfuegos province.

Taking into account the above, the objective of this work was to identify associated vegetation and harmful organisms in *Acacia mangium plantations*, in the municipality of Abreus Cienfuegos, Cuba.

MATERIALS AND METHODS

Acacia mangium plantation areas, belonging to the Abreus Base Business Silvicultural Unit, subordinate to the Cienfuegos Agroforestry Group, the period from January 2010 to December 2021; The areas are located at the coordinates X1 539-200, Y1 271-367.43 Northeast and X2 528-011.12, Y2 263-309.14 Southwest (Geocuba, 2021).

The plantations where the observations took place were between two and 12 years old and had different silvicultural management characteristics from the pruning point of view. The planting density was (3 x 2) for a total of 1166 trees *l* ha. In the Abreus municipality, 439.9 ha of *Acacia mangium* are planted, representing 25.5% of the total plantations in that territory (1721 ha). This species grows in areas of flat relief, on Yellow Ferralitic Quartzite, Red Leached Ferralitic and Yellow Ferralitic soils, in climatic conditions of temperature of 32.8 - 35 ° C, rainfall from 30 to 261.8 mm monthly average and relative humidity up to 83%. In addition, they are located 60 meters above sea level.

The observation and collection of harmful insects, damage characteristics and signs caused by them was carried out through periodic visits to the plantations and fixed plots, including the rainy period and the dry period. The collections were carried out over a period of 30 months (Lores *et al.* 2011) (Figure 1).

Figure 1. - *Location of A. mangium plantations.*

Source: Planning Project. Cienfuegos Agroforestry Group, 2022

Inventory of associated vegetation

An inventory of the associated vegetation was carried out according to Meseguer *et al* (2016). Nine points of one m² were covered for each plot in zig-zag diagonals and, based on a visual estimate, vegetation samples were collected, each one was placed in nylon bags, with its identification (plot number, lot, stand and age of the plantation, date and time), and they were taken to the herbology laboratory belonging to the Plant Health

Laboratory for later identification. For this purpose, the herbarium of the taxonomic keys section and consultations with national experts were used.

Inventory of insects and diseases

30 samplings were carried out by surveying 20 plots of 10 x 10 (100 m²), in which 460 trees were randomly sampled. Within the plots, zig-zag transepts were made. For the collection of samples, the method of direct sampling of the plants was used, for which 23 plants were selected in each plot, observing leaves, branches and stems, as well as the ring in order to detect eggs, larvae and adult insects. Sticky traps were used, which consisted of rubber bands previously permeated with entomological glue to capture insects. These were placed from 0.5 to 1.0 meters high on the stems, to capture individuals that move along them, and pits of approximately 0.5 x 0.5 meters were made, to detect those insects that live in the soil and in this way collect larvae, pupae and adults found among the leaf litter (Hochmut and Milan, 1975).

The affected parts of the plants are taken and placed in previously inflated plastic bags, which are then sealed. A fine brush or needle with a handle is used to collect the insects and transfer them to small jars with 70% alcohol. Each jar contains the following information: geographic location of the stand, age of the plantation, date and time.

Later in the laboratory, the identification was carried out using the necessary keys and materials, as well as the existing insect collection, by the specialist from the entomology laboratory belonging to the Provincial Laboratory of Plant Health.

To identify the diseases, leaf samples and apical parts that presented symptoms were collected over a 30-month period. These were placed in plastic bags and paper bags, duly labeled. The leaf samples were wrapped in moistened newspaper to maintain humidity and were taken to the Provincial Laboratory of Plant Health (LAPROSAV) for identification.

The humid chamber process was carried out, incubating at a temperature (25 ± 2 °C) with alternating light for a period of three days, for its identification the microscope-stereoscope was used. According to the Normative Operating Procedure (PNO 2020) everything was carried out by the specialist of the mycology laboratory belonging to the Provincial Laboratory of Plant Health.

The calculation of the frequency of appearance was carried out with the values of composition and population densities of the species identified in the forest plantations of *A. mangium*. For this purpose, the equation indicated by Norton (1978) cited by Fernández (2018) Equation 1 was used.

$$\text{Frequency of occurrence} = \frac{\text{Number of samples containing a species/genus}}{\text{Number of samples analyzed}} \text{ x } 100 \quad (1)$$

The evaluation of the frequency of appearance values will be carried out using the Masson and Bryssnt scale (1974), which indicates that a species is Very frequent if Fi> 30; Frequent if 10 < Fi < 30; Infrequent if Fi<10.

RESULTS AND DISCUSSION

The botanical families most represented in the study were Poaceae and Malvaceae (Figure 2). These results coincide with Meseguer *et al*. (2016), where he refers to studies carried out in Cuba that: *Sorghum halepense* (L), Pers, *Sporobolus indicus* (L) R.Br, *Cynodon dactylon* (L)Pers, *Cenchrus echinatus* L, while *Guazuma ulmifolia* , Lam, *Walteria indica* L, *Corchotussi liquosus* L, *Sida urnifolia* Mill, are found in large areas of crops or in homogeneous agroecosystems with a single species and different climatic conditions, a situation faced by *Acacia mangium plantations* in the Abreus municipality, Cienfuegos province.

Other studies carried out by Padrón (2007) in Cuba, show that species such as *Chloris virgate* Sw (Indian beard), *D. annulatum* Forsk (jiribilla), *Hylocereus spp* .(pitilla), *Sorghum halepense* (L) Pers .(don carlos) and *Sporobolus indicus* (L) R. Br. (esparto grass), are invasive and very dangerous for crops, they also interrupt the agricultural work that is carried out and provide large quantities of seeds that facilitate their reproduction.

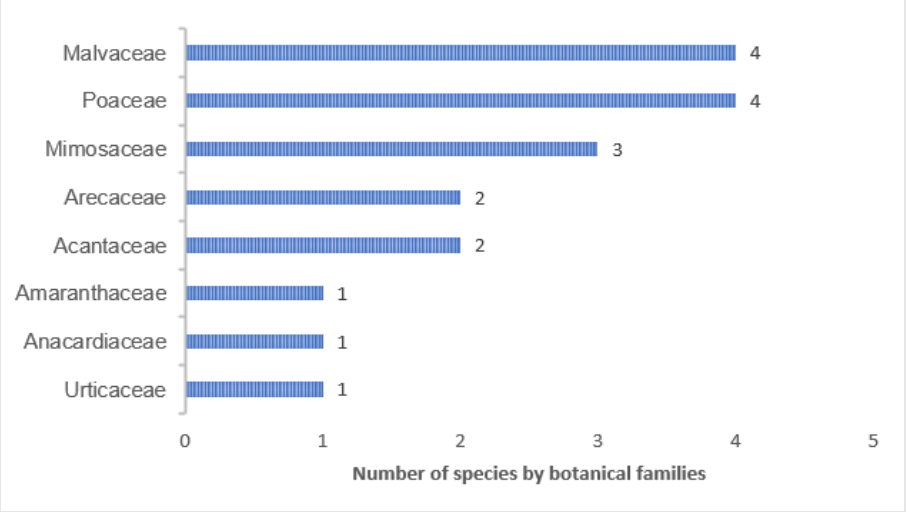

Figure 2. *- Number of species by botanical families*

A. mangium plantations were found in the 20 sampled plots (Table 1).

Vegetation can generally be herbaceous-shrub, made up of fast-growing, invasive and heliophilous species typical of sunny and open places, established by human action after natural vegetation is eliminated, when reforestation is carried out, where the vegetation is identified, which is linked to the type of crop with which it is established (García, García *et al.*, 2023).

The species *Dichrostachys cinerea, Acacia farnesiana, Mimosa pigra and Sorghum* halepense , were present in the 30 samples taken in the study, which means that they are very dangerous for *Acacia mangium* plantations , due to their rapid growth rate. and in addition to being invasive, they compete for space, nutrients and accumulate large amounts of combustible material and make forest areas vulnerable to fires. (Vásquez, C. A *et al*, 2020). Many of these species were present before the *Acacia mangium plantations,* in areas of sugar cane cultivation and livestock at the time when soil preparation work was carried out, which their seeds and livestock favored their continuation, interrupting maintenance work in these areas.

Table 1. - *Vegetation associated with A. mangium plantations*

No	Scientific Name	Common name	Family
1	*Ruellia tuberosa* L	Jumping parrot	Acantaceae
2	*Comocladia dentata* L	Wow	Anacardiaceae
3	*Achyrantes aspea var . indica* L.	Cat's tail	Amaranthaceae
4	*Corktussi Liquorice* L	Tea mallow	Malvaceae
5	*Sida ulmifolia* Mill	Horse Mallow	Malvaceae
6	*Dichrostachys cinerea* L Wight & Arn.	Marabou	Fabaceae
7	*Acacia farnesiana* (L) Willd	Scent	Fabaceae
8	*Mimosa pigra* L	Weyler	Fabaceae
9	*Walteria indica* L	White mallow	Malvaceae
10	*Bursera simaruba* (L.) Sarg	Almacigo	Anacardiaceae
11	*Roystonea regia* (Kunth)	Royal Palm	Arecaceae
12	*Sabal domingensis* ,Becc	Cone palm	Arecaceae
13	*Guazuma ulmifolia* Lam	Guácima	Malvaceae
14	*Cecropia peltata* L	Yagruma	Urticaceae
15	*Sorghum halepense* (L) Pers	Don Carlos	Poaceae
16	*Sporobolus indicus* (L) R. Br	Esparto grass	Poaceae
17	*Cynodon dactylon* (L) Pers	Fine grass	Poaceae
18	*Cenchrus echinatus L*	Stew	Poaceae

Forest pest problems in Cuba are considered to be main components in forest management, for which there are state programs and a scientific, surveillance and technical assistance infrastructure.

Controlling damage caused by pests in forest sites cannot be done by applying chemicals, since these sites are extensive, have relations with different productive and social spheres, and could cause water and soil contamination and irreparable damage to the environment. The fight against these harmful agents must be carried out through integrated management and strategies (Rivera & Mandujano, 2023). These strategies should include preventive measures for pest control at the time of planning and establishing forest plantations, as well as the conservation of the natural habitat to encourage the development of natural enemies such as parasites, parasitoids and predators.

One of the main elements to consider to prevent pests is the diversification of plantations, avoiding as far as possible large mono-specific extensions of pines or broadleaf trees (Abella *et al.*, 2023).

In the insect inventory carried out on *A. mangium plantations, five species of* hymenoptera stand out. Studies carried out by Fontanela (2020) indicate that when there is a greater diversity of plants and a lower intensity of management, there is a greater abundance of ants. In this regard, Fuster (2021) states that ants have beneficial effects on pollination, seed dispersal and protection, in exchange for food resources and nesting spaces. The study highlights *Acromyrmex spp* and *Atta spp*, species of agricultural importance because they are eminent cutters. (Scherf *et al.*, 2023) points out that these species make up the so-called pruning, cutting, farming or mushroom -eating ants, they live underground, making galleries, with wide spaces that constitute the bonfires. In Cuba there are three species of bibijaguas: *Acromyrmex octospinosus* Reich, 1793; *Atta cubana* Fontenla, 1995 and *Atta insularis* Guérin, 1944; the species of the genus Atta are considered exclusive to the country. They have preference regarding the material they have to prune, mostly dicotyledons. Martínez, (2020) also attach great importance to these two genera due to the direct and indirect damage they cause in various crops, including forest plantations.

These results coincide with those proposed by Lores (2011), in Colombia, where he identified insects of the Hymenoptera order such as *Atta colombica in commercial plantations of Acacia mangium on the Atlantic Coast. Atta laevigata, Atta cephalotes* (leaf-cutting ant, leaf-cutting ant, gobbler). These insects attack during the establishment period of plantations and cause damage in the form of semicircular cuts to the phyllodes of young seedlings (Figure 3).

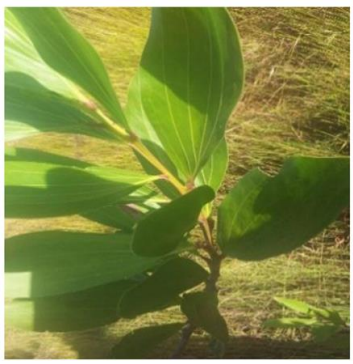

Figure 3. - *Damage caused by Attas insularis*

However, Fuster (2021) reports that *A. mangium* has a high competitive capacity that facilitates its establishment and cultivation, even in dense and pure stands, which can be planted in monoculture without problems of insect damage.

In the study, 14 species of insects were identified, which based on the classification criteria of Masson and Bryssnt (1974) resulted in the species *Atta insularis* (Guer), *Acromyrmex octospinosus* (Reich), *Paratrechina longicornis* (Latreille), *Monomorium florícola*. (Lerdon), *Anochetus maury* (Emery), *Diabrotica balteata*, (Leconte), *Mosis latipes* , (Guenée), *Brevipalpus sp* (Baker), *Agromyza sp,* (Michelsen), *Cryptiserya genistae*, *Alagonasa decemgittata*, Bechyné, *Solenopsis invicta* Buren are very frequent (Phi> 30) while *Eulema melanopa* , (Ehrenberg), *Oxymerus aculeatus*, (Lebasi) are classified as frequent (10 < Fi < 30) (Figure 4)

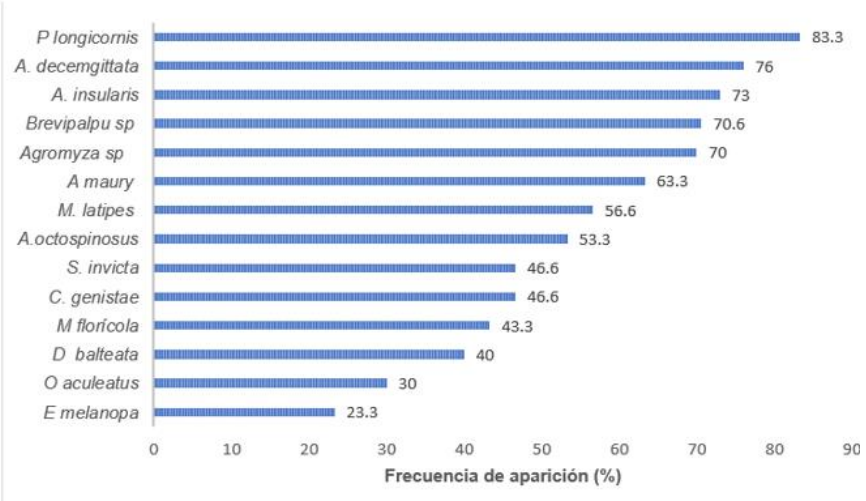

Figure 4. *- Frequency of appearance of insects in A. mangium plantations*

Countries such as Colombia, Ecuador and Chicle, consider among the main problems of phytosanitary origin in *Acacia spp*., diseases occupy an important place in the appearance of symptoms, which in most cases appear causing fungal damage to the foliage of the plants. (Arguedas *et al*., 2021). However, in Malaysia, diseases such as heart rot, root rot, phyllode rust are reported, which are a potential threat to *Acacia mangium* causing devastating effects in the early stages of cultivation.

In these plantations, diseases occur that require the implementation of Integrated Pest Management (IPM) programs, which require a deep knowledge of the population dynamics of these agents, their damage and the multiple interactions with the various factors that intervene in forest agroecosystems Aquino *et al.* (2021).

One of the main problems arising from this situation is the homogenization of forest systems, which increases the vulnerability of crops to diseases, which can be devastating if they affect a uniform crop, especially in large areas, such as the current areas of *A. mangium plantations* in the Abreus municipality (ETPP 2023).

Like all forest species used in reforestation programs, *A. mangium* is subject to damage from diseases and disturbances of abiotic origin, especially nutritional disorders. Hernández *et al.* (2021).There are other physical, chemical and climatic factors that can arise from its location outside the range of environmental conditions, the affectation by fungi can be found in any of the structures that make up the plant: root, stem, branches, leaves and petioles, even in the seed (pre or post -harvest), at any stage of development, from seedlings in the nursery to adult specimens in established plantations of more than five years, associated with a wide range of hosts. (Ramírez, 2018).

Among the fungal diseases reported in *A. mangium plantations in the* Abreus municipality, the following stand out: *Cercospora spp* (Figure 6) and *Pseudocercospora spp , Colletotrichum* leaf spot *spp* , algal leaf spot and *Pestalotiopsis leaf spot spp* (Figure 5).

Figure 5. *- Cercospora damage spp in Acacia mangium*

Figure 6 shows the frequency of occurrence of diseases that were present during the monthly samplings over the 30-month period. Very frequent (Fi> 30): *Pestalotiopsis acaciae* (Spge), *Colletotrichum gloeosporoides*, (Penz), *Cercospora spp* (Ellis), *Pseudoperonospora spp* (Link), *Oidium spp* . (Cooke), *Uredo hymineae* (Broome), *Corynespora spp* , (Kawam). Common (10 < Fi < 30) *Zygosporium spp* (Sacc), *Phoma sp*, (Saccardo), *Phomosis spp,* (Fawcett), *Graphium spp* (Corda); and Uncommon (Fi<10), *Cephaleurus virensis* (Kunce) (Figure 6).

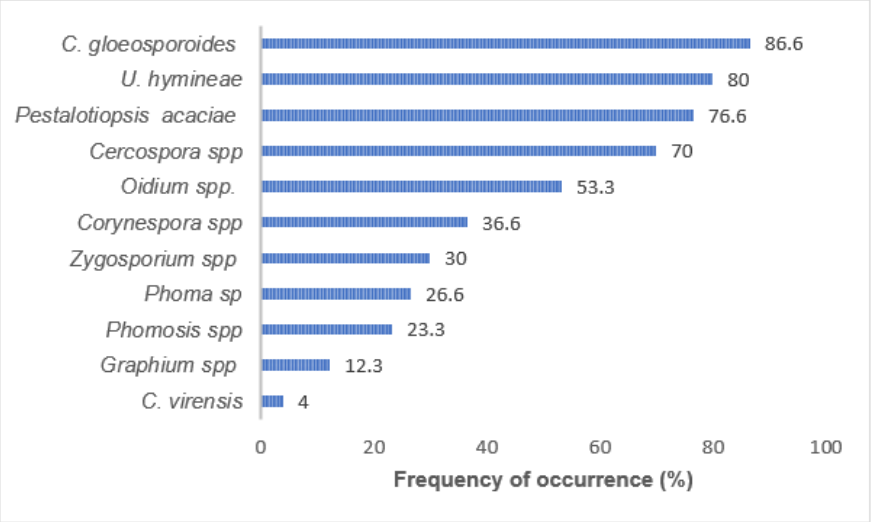

Figure 6. *- Frequency of occurrence of diseases in A. plantations. mangium , in the municipality of Abreus, Cienfuegos province*

CONCLUSIONS

Invasive species were identified in plantations of Acacia mangium Dichrostachys cinerea, Acacia farnesiana, Mimosa pigra and Sorghum halepense.

The insect Paratrechina longicornis (83.3 %) and the disease Colletotrichum gloeosporoides (86.6 %) occurred most frequently in the inventory.

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The authors declare not to have any interest conflicts.

***Contribution of the authors*:**

The authors have participated in the writing of the work and analysis of the documents.