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Estudio de la flora adventicia y sus cambios en función de la tecnología
Study of the adventitious flora and its changes as a function of technology

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Resumen

El trabajo tiene como objetivo determinar el estado actual del agroecosistema cafetalero de la Cooperativa de Créditos y Servicios Luis Antonio Carbó, ubicada en la comunidad de Limonar de Monte Ruz, municipio El Salvador, provincia Guantánamo. Permitirá enriquecer la actualización de bases de datos de la biodiversidad; en el periodo comprendido entre octubre de 2021 y noviembre del 2022, donde se monitorearon y se levantaron parcelas de 20x25 m^2, se identificaron un total de 16 especies arvenses distribuidas en nueve familias botánicas, una de las cuales es monocotiledonea y ocho son dicotiledonea. La familia con más especies encontrada fue la Poaceae, con cuatro, seguida de la familia Asteraceae con tres, la Amaranthaceae con dos. El resto de las familias están representadas con una especie cada una, y la familia Poaceae fue la más abundante dentro de los sistemas estudiados. Para el estudio se emplearon métodos del nivel teórico y empírico.

Palabras clave: Arvenses; Botánicas; Monitoreo; Monocotiledonea; Dicotiledone.

Abstract

The work aims to determine the current state of the coffee agroecosystem of the Luis Antonio Carbó Credit and Services Cooperative, located in the ***community*** of Limonar de Monte Ruz, El Salvador municipality, Guantánamo province. It will allow enriching the updating of biodiversity databases; in the period between October 2021 and November 2022, where plots of 20x25 m2 were monitored and surveyed, a total of 16 weed species distributed in nine botanical families were identified, one of which is monocotyledonous and eight are dicotyledonous. The family with the most species found was Poaceae, with four, followed by Asteraceae with three, and Amaranthaceae with two. The rest of the families are represented with one species each, and the Poaceae family was the most abundant within the systems studied. Theoretical and empirical methods were used for the study.

Keywords: Weeds; Botanicals; Monocotyledonous; Monitoring; Dicotyledonous.

Introduction

In mountain agroecosystems, a major problem is the management and conservation of natural resources, especially biological diversity, which is a consequence of a numerous group of causes, among which are the degradation of phyto- and zoogenetic resources, the lack of biodiversity monitoring and management systems to manage the risk derived from extreme climatic events, and the lack of identification of biodiversity elements.

The adventitious plants that grow in coffee agroecosystems, far from being weeds, as they are unfairly called, provide us with information about the state and composition of a cultivated land, something that helps us to understand the environment without having to carry out any type of laboratory analysis. Adventitious plants, commonly known as weeds, are those plants that develop in the soil without having been planted by the farmer, that is, they grow spontaneously. They are plants with rapid, annual cycles, since they can thus pass the most unfavorable season as seed, avoiding having to invest material and energy.

This energy and matter is destined to seed production, so that when the most unfavorable stage arrives, there is infinity of seeds with the capacity to germinate, which guarantees the plant the possibility of colonizing new spaces. This colonization capacity is even greater since each of the seeds has a high germination percentage and is capable of being preserved for long periods of time. They are also indicator plants, i.e. they indicate the state of the soil in which the crop is located according to the degree of fertility, its structure, pH, and can even provide information on the nitrogen content.

Previous research has indicated the need to know the critical period of competition between weeds and economic crops. Therefore, there is still a lack of information on the subject with special significance in Cuba, where very aggressive species predominate as a consequence of the indiscriminate use of herbicides during the 80's and part of the 90's and where their consequences still persist.

Weeds are plant species that affect the agronomic productive potential of the occupied area or the volume of water managed by man. It is generally accepted that weeds are useless and undesirable; their growth is aggressive, vigorous and competitive; they are persistent or resistant to the measures used to control them, harmful to humans, animals and crops; they have a high capacity for reproduction and dissemination, and disfigure the landscape; they are versatile and respond relatively easily to ecological disturbances. Few plants associated with crops meet these characteristics and the farmer's tendency is to consider undesirable any species with any of these characteristics.

On farms, weeds have a negative impact on the quantity and quality of products because they make it difficult and expensive to combat pests and diseases, as well as the harvesting process. They also devalue agricultural land, increase the maintenance costs of irrigation structures, cause allergies or poisoning to humans and animals, and consume a large part of the available nutrients and water.

Thus, before implementing processes to reduce the number of adventitious plants, it would be advisable to observe the species that can be found.

Among their benefits, we should also mention their function as improvers, since certain species can bury themselves in the soil as green manure, improving certain aspects of the soil for the following crops. One of the main biotic constraints affecting production in coffee agroecosystems is the presence of weeds, since they reduce yields due to allelospolia and allelopathy, as well as being hosts of certain insect pests and diseases. Thus, production costs increase due to the use of different measures to control populations. These interference effects on yields depend on the density and the predominant species, especially during the period of the crop cycle, in which there is greater interference of weeds, the study of weed flora is a basic tool for effective management for the benefit of the crop.

All of the above exposes the fragility of the plant formations of the ecosystems and their biota in general, whose maximum values of diversity are associated with these geographic zones. It is precisely in these sites where most of the Cuban coffee-growing areas are developed, which border or are imbricated within these ecosystems, in direct interaction with the components of biodiversity that integrate them.

In Cuba, there are few studies focused on determining the biodiversity values of coffee ecosystems, making it difficult to evaluate the role of these agroecosystems in the conservation of local biodiversity. The objective of this work is to determine the role of the coffee plantations of the CCS Luis Antonio Carbó in the conservation of the biodiversity associated with them.

Therefore, the objective of this research is to determine the current state of the coffee agroecosystem of the Luis Antonio Carbó Credit and Service Cooperative, located in the community of Limonar de Monte Ruz in the municipality of El Salvador, Guantánamo province, which will allow enriching the updating of biodiversity databases.

Development

For adventitious weeds not to be a problem for the correct yield of the crop, there must be a balance between the crop and the weeds. This can be achieved by implementing a series of practices, which can be divided into preventive and direct cultural practices:

- Preventive cultural practices.
- Crop rotation and association.
- Soil tillage.
- Fertilization
- Direct cultural practices.
- Mulching: soil cover through the use of different materials.

Using native species in crops, since they will be much more adapted to the agro-ecosystem in which we find ourselves, thus being able to be more aggressive against competing species.

There are two key moments in the development cycle of these plants for the application of these control techniques, which are the active growth stage, in which the plant has possession of part of the soil with its roots, and the flowering stage, when the composition reaches its maximum richness, both in terms of variety of substances and assimilation.

Etymological origin of the family name

The name of the genus Poa comes from the Greek word that defines grasses or forage plants (Freire, 2004). This family was formed by 6 subfamilies: Bambusoideae, Oryzoideae, Arundinoideae, Pooideae, Chloridoideae and Panicoideae; and this classification is the one followed by (Rúgolo de Agrasar et al., 1998), in the Flora Chaqueña, one of the most recent publications about grasses. However, (Grass Phylogeny Working Group GPWG, 2012,), recognized 12 subfamilies within Poaceae.

Methodology for the characterization of the weed population in the studied areas

Initially, a general inventory was made of the weed species present in the Credit and Service Cooperative (CCS), Luis Antonio Carbo. The Pitty and Muñoz (1991) plant recognition manuals were used for species recognition and identification. The following web pages were also consulted: Segovia, and Alfaro. (2008), and the knowledge acquired in the identification of weed species.

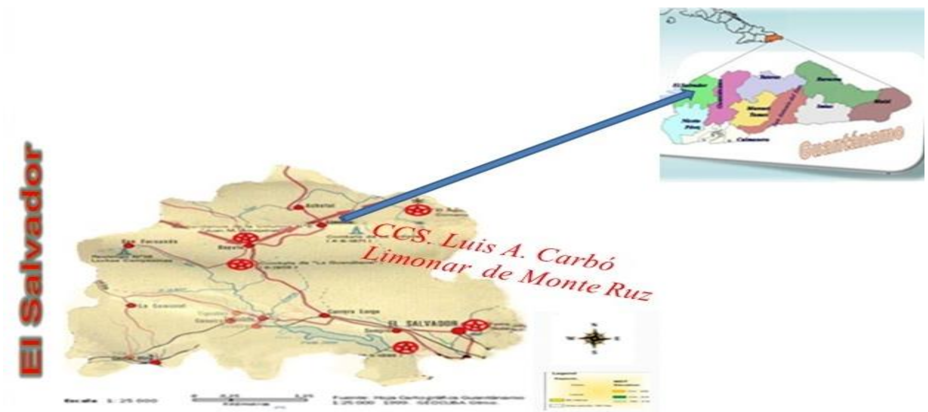
Sampling method

The minimum sampling area was determined; a parameter that indicated the most appropriate size to be used to carry out the corresponding measurements, based on the methodology described by Fuentes (1986), which relates the number of species appearing in the sample to the increase in the area under sampling. A metallic frame of 0.25 m2 (0.5m x 0.5m) was randomly dropped in a coffee site of the CCS Luis Antonio Carbó, determining the number of species that appeared.

Location of the study area

The study area is located between parallels 189 and 191 of North latitude and meridians 657 and 659 of West longitude, in the Nipe - Sagua - Baracoa Mountain Massif, at 405 masl, location, Limonar de Monte Ruz in El Salvador municipality, Guantánamo province, between October 2021 and November 2022 in a coffee agroecosystem (Figure 1). The research was conducted at the Credit and Service Cooperative (CCS) Luis Antonio Carbo in 0.1 ha of coffee plantations, Guantánamo province, Reyes and Acosta (2011), it is the rainiest part of the province and especially of stratified clouds.

Figure 1 Research area



Source: Own elaboration

Climatic characterization of the study area

Climate is one of the most influential phenomena in the spatial differentiation of the massif. To the north and northwest, the highest precipitation values in the country are reported, with more than 2500 mm/year, and to the south, the driest zone with rainfall below 600 mm/year, Soto (2001).

Results

In 2020, a total of 15 weed species were found distributed in nine botanical families, one of which is monocotyledonous and eight are dicotyledonous. The family with the most species found was the Poaceae with four, followed by the Asteraceae family with three, the Amaranthaceae with two. The rest of the families are represented with one species each.

In the year 2022, a total of 21 species distributed in seven families were found, which increased with respect to 2020, the family with more species recorded in the monitoring was the Poaceae with four and in 2022 this same family was recorded with seven species in the studied agroecosystems which shows an increase of this family and species must be due to the viability of their seeds that are suckling in the soil.

Discussion

When carrying out a study on the behavior of the monitoring of the weed flora in the year 2020, with respect to the six months of the year 2022, it could be observed that there was a decrease in the number of weed species reported in 2020, this could be due to the drought period that has existed in this mountainous area with respect to the previous year and to the different tasks that are performed to the crops during their vegetative cycle, This can reduce the abundance of weeds, while in the rainy period a greater quantity may appear, since many of them, their seeds may be dormant in the soil and with the humidity they can reproduce more easily than in the drought period, as shown in table 1.

In 2020, a total of 15 weed species were found distributed in nine botanical families, one of which is monocotyledonous and eight are dicotyledonous. The family with the most species found was the Poaceae with four, followed by the Asteraceae family with three, the Amaranthaceae with two. The rest of the families are represented with one species each.

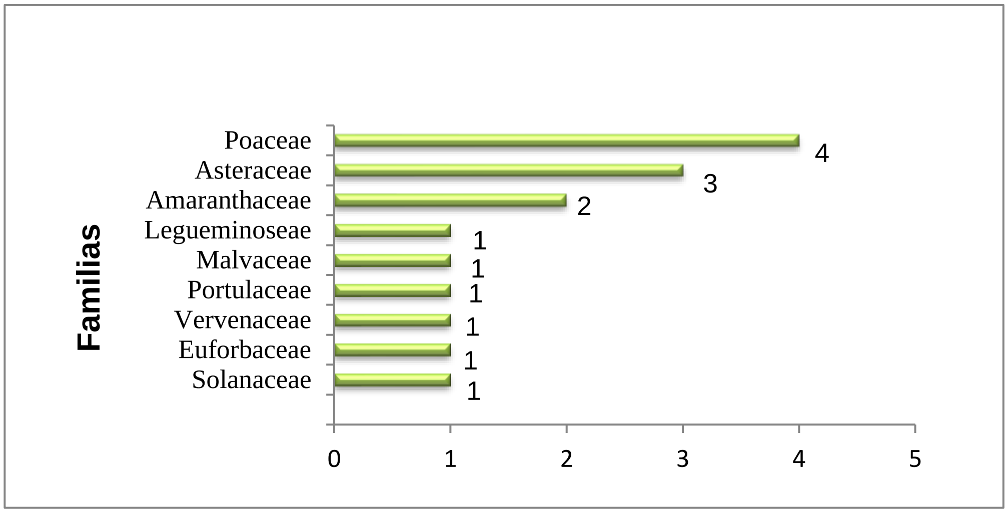
In 2022, a total of 21 species distributed in seven families were found, which increased with respect to 2020.

Table 1 Species of arboreal flora in coffee-growing areas in the year 2020

Nombre Vulgar		**Nombre Científico**
1	Arrocillo	Echinochloa crusgalli L.
2	Lechero	Chamaesice hirta L.
3	Hierba de Don Carlos	Sorhhum halepense L.
4	Romerillo Blanco	Bindens pilosa L.
5	Moriviví perenne	Mimosa púdica L.
6	Orozuz	Phyla dulcis
7	Bledo	Amaranthus spinosus L.
8	platanillo	Asclepias cuvossavia
9	Campanilla (Flor amarilla)	Convolvulus savaticus
10	Campanilla (Flor Blanca)	Convolvulus savaticus

Source: Own elaboration

Graph 1 shows the most represented families in 2020. The family with the most species was Poaceae with four, followed by the families Asteraseae with three, Amaranthaceae with two, and the rest of the families with one species each. The appearance value of Poaceae in this study corroborates the existing references on this botanical family considered as one of the most numerous, consisting of almost 700 genera and about 12,000 species. "It is estimated that grasses occupy 20% of the world's plant surface, and it is also considered as the fourth family in importance by the number of species, and certainly the first for its economic interest ” (Sánchez, Medrano, 2018). Graph1. Families present in the study area in 2020.



Source: Own elaboration

Table 2 shows the number of weeds monitored in 2022, with 21 species distributed in seven families, which increased with respect to 2020. Several weeds of economic importance in the cultivation of coffee and other crops belong to the Poaceae family; in similar studies of corn crops in six locations in Aragua state, it was found that most of the species belonged to this family, followed by Euphorbiaceae and Malvaceae Blanco, Leyva and Castro (2014). In studies of corn crops in six localities of Aragua state, it was found that most of the species corresponded to that family, Poaceae, followed by Euphorbiaceae and Malvaceae Blanco, Leyva and Castro (2014).

Table 2 Number of weeds monitored in coffee growing areas in the year 2022

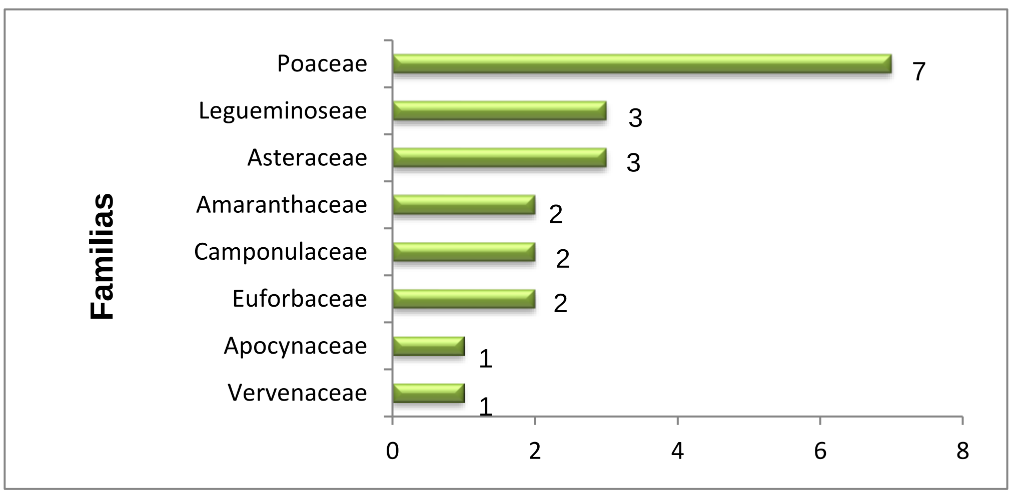
Nombre Vulgar		Nombre Científico
1	Arrocillo	Echinochloa crusgalli L.
2	Hierba mora	Solanum modiflorium Jacp.
3	Romerillo Blanco	Bindens pilosa L.
4	Romerillo Amarillo	Bidens cynapiifolia Kunth.
5	Bledo	Amaranthus spinosus L.
6	Oro Azul	Phyla nodiflora
7	Verdolaga anual	Portulaca oleracea
8	Malva común	Melochia pyiramidata L
9	Moriviví perenne	Mimosa púdica L.
10	Verbena azul	Stachytarpheta jamaicens L.
11	Guisaso de caballo	Xanthium strumarium L
12	Rabo de gato	Achyranthes indica L.
13	Canutillo	Commelinaerecta L.

14	Pata de gallina	Eleusine indica L.
15	Hierba de Don Carlos	Sorhhum halepense L.
16	Lechero	Chamaesice hirta L.
17	Zacate perfumado	Oplismenus hirtellus
18	Pata de gallina	Eleusine indica
19	Pasto ilusión	Eragrostis lugens
20	Esparto	Sporobolus indicus
21	Chloris radiata	Chloris sp

Source: Own elaboration

Graph 2 shows the families monitored in 2022, with a total of nine species of weeds distributed in six botanical families, with the Poaceae family being the most represented with six species respectively, followed by the Legueminoseae and Asteraseae families with three species, the Amaranthaceae, Amaranthaceae and Euphorbaceae families with two each, and the Apocynaceae and Vervenaceae families with only one family each.

Figure 2 Families presented in the study area in 2022



Source: Own elaboration

According to the total number of species found in the inventory, it can be observed in Graph 2, that as the sampling area was extended, more species of weeds belonging to the Poaceae family appeared until reaching a point where the area increased three times more and no more species appeared, and a total of seven species of the Poaceae family were found.

A similar behavior was reported by Gámez, et al. (2014), when they pointed out the Poaceae family as the most represented floristic group in different agricultural production systems. They also added that in different studies this family is considered as the most numerous and that the most important weed groups generally belong to it.

Blanco (2016), pointed out that 50% of the worst weed species in the world are found in the Poaceae and Asteraceae families. Precisely these families together with Euphorbiaceae, Leguminosae, Malvaceae and Convolvulaceae, are the ones that contribute most to the behavior of weed species. Many of these families were reported by Blanco (2016), how the most plant species considered as non-useful contribute to agricultural ecosystems.

The predominance of annual plants over perennials may be conditioned by frequent chemical control. These species have been maintained over time by a process of adaptation and persistence due to the integration of ecological, climatic and edaphic factors, as well as intensive management for coffee production and the combination of high seed production per plant, dormancy and prolonged viability; these seeds once established in the soil, it is practically impossible to control them efficiently.

Similar behavior to those shown here, both for the most abundant and the most frequent species, were reported by Candó et al. (2015), when evaluating the behavior and functionability of the existing flora in four suburban farms in Santiago de Cuba.

From the point of view of this author, he points out that when comparing the arvense vegetation in both productive periods (low rainfall and rainy), that for the indicator repetition per farm of the species, these increased from one season to the other. The seeds of many plants considered arborescent have a long dormancy period, which keeps them viable until they find conditions conducive to germination.

After applying the tillage technology, the most used by the producers, the number of weed species was evaluated, where it was observed that they decreased, with a predominance of the arrocillo, white and yellow rosemary, and the milkweed in the coffee sites, It could be observed that the most abundant species when tillage is carried out is the arrocillo in tillage areas, not observing this species in other coffee sites where the Bledo and Caramana species predominate, the latter being the one of greater concern on the part of the producers as shown in (table 3).

Table 3 Species that predominate after the technologies applied

Especies Predominantes	**Nombre Científico**	**Año 2020**	**Año 2022**
Arrocillo	Echinochloa crusgalli L.	X	-
Lechero	Chamaesice hirta L.	X	X
Romerillo Blanco	Bindens pilosa L.	X	X
Romerillo Amarillo	Bidens cynapiifolia Kunth.	X	X
Bledo	Amaranthus spinosus L.	X	-
Caramaná	Cyperus rotundus l.	-	-
Zacate perfumado	Oplismenus hirtellus	-	X
Pata de gallina	Eleusine indica	-	X
Pasto ilusión	Eragrostis lugens	-	X
Esparto	Sporobolus indicus	-	X
Chloris radiata	Chloris sp	-	X

Source: Own elaboration

According to (Blanco and Leyva, 2010), within agroecosystems, weeds are plant species that, when living in competition with economic crops, reduce their yields; however, in the theoretical conception of sustainable agriculture, weeds are a key element to consider, and their management is aimed at improving or solving problems of erection, coverage, conservation and composition of soil fertility.

On the other hand, this vegetation can have many uses for humans, such as medicinal, food, ornamental, nitrogen-fixing or repellent plants.

These results, where Poaceae constitutes the most representative floristic group in different agricultural production systems, corroborate the results of Candó et al. (2015), who consider it the most numerous botanical family. These results coincide with those reported by Guerreo (2017), when he pointed out during a study of the potentialities of plant diversity in suburban agricultural farms for natural pest control that exotic and invasive species occupied the largest proportion of the vegetation.

He also added that this behavior is a cause for concern in terms of developing actions to ensure the presence of this important component of agrobiodiversity in agricultural ecosystems.

Weeds perform a positive function in terms of soil protection, providing the producer with benefits such as:

- They protect the soil from erosion, improve its structure and stimulate soil biological activity.
- They can be used as green manure, providing nutrients and organic matter.
- They provide a more favorable microclimate for crops.
- They provide biodiversity, harboring beneficial fauna (bees, natural enemies of pests, etc.).
- Serve as trap plants for crop pest pests.
- They are the basis for the phytogenetic improvement of crops.
- Many serve as food for livestock.

There are a series of preventive measures that allow the farmer to have a better control of these weeds such as the use of varieties adapted to the climatic and edaphological characteristics of the area, the use of allelopathic crops that are capable of producing substances that prevent germination or inhibit the growth of numerous species of adventitious plants.

The integrated management of nutrients provided by weeds is essential; recyclable waste fertilizes the soil by providing nutrients in crop or crop rotation systems. The contribution of nutrients from organic residues to the new crops that are planted is also monitored, which will include the contribution of leaf litter in coffee systems, determining the additional nutrient needs that the soil requires.

Agriculture has a high potential for climate change mitigation. Among the recommended measures that have an impact on mitigation are:

- The reduction of chemical fertilizers, the retention of organic matter in the soil.
- The protection and rational use of forests.
- The development of production systems that require fewer external inputs, high productivity and total production, such as agroforestry systems.

Many of the adaptation measures and technologies are part of the local knowledge base and need to be complemented by research into new technologies and their dissemination. Local culture is key to streamlining adaptation responses, as they can generate an adaptive combination of traditional and scientific technologies.

Conclusions

In the survey and monitoring carried out in the Luis Antonio Carbó Credit and Service Cooperative, it was found that the family with the greatest number of species found was the Poaseae, with four, followed by the Asteraceae family with three, the Amaranthaceae with two species respectively, which provide nutrients to the coffee system for its development, highlighting the Leguminoceae family with a number of individuals providing nitrogen to the soil. With this sustainable technology of planting leguminous plants in the coffee systems, the quality of the soil and the integral development of the sites studied were improved through the transfer and technological innovation, determining the weed families that provide nutrients to the soil and enriching the updating of databases of biodiversity in mountain agroecosystems.

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