# Edaphic mesofauna, some studies done: a review.

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## Abstract

**Introduction**: The soil is a complex ecosystem considered the one inhabits where a number of organisms, microorganisms, minerals, organic matter, water and air live, physical, chemical and biological activities take place in it.
**Objective**: To analyze updated information on research that addresses the role of the mesofauna in relation to soil quality.
**Methodology**: Documentary sources were used to search the bibliographic documents. A bibliographic search was carried out until September 2021 based on: writing scientific articles and books, making an analytical and critical reading of the information on edaphic fauna with an emphasis on the last decade. The information was taken from the internet using the search engine "academic Google", Dialnet and the Wiley Online Library.
**Results**: oribatid mites and collembola are the most abundant arthropods and with the highest specific diversity in the soil, they are diverse groups, biological indicators of soil quality, it is favored by agroecological practices such as coverage and it is affected by the indiscriminate use of agrochemicals.
**Conclusions**: the mesofauna is favored by agroecological practices such as the association of crops, plant covers and the incorporation of crop residues, use of organic inputs such as compost, implementation of easily degradable plants, zero tillage, bare soils. And it is mainly affected by the exploitation of a single plant species with high applications of agrochemicals, climatic changes, anthropic disturbances of the edaphic environment, changes in land use, soils without cover and mechanized soil preparation.
**Keywords**: Litter; decomposition; bioindicators; soil biology; organic materia

**INTRODUCTION**:

The soil is one of the most complex ecosystems in the world and one of the most diverse habitats on the planet: it is home to an infinite number of different organisms that interact with each other and contribute to the global cycles that make life possible, serving as indicators of the soil quality, the implementation of agroforestry systems and silvopastoral systems have been widely recommended, because they offer environmental services, including allelopathies, protection of pollinators and natural bioregulators of pests, as well as improvements in soil biology, a large part of the soil mesofauna intervenes in the most important processes of the soil, such as the decomposition of organic matter, constituting an important characteristic of soil quality [1].

There are several ways to classify soil organisms: size is usually the main criterion, added to aspects of mobility, eating habits and the function they perform. As the classifications are most commonly used to imply the separation of two animals according to body diameter or compression, the trophic activities of these animals include both the consumption of microorganisms and microfauna, as well as the fragmentation of decomposing plant material. Springtails play an important role as detritivores, contributing to the decomposition of organic matter and the control of populations of microorganisms, especially fungi, while mites act mainly as predators, controlling the populations of other organisms in the soil, especially the microbiota [2].

The mesofauna groups are microscopic individuals, between 0.2 to 2 mm in diameter. They live in the litter and/or inside the soil and among their members we can mention soil mites, springtails, prothurs, diplures, Psocoptera, Thysanoptera or thrips, pauropods, symphyla and enchytreids [3].

The edaphic mesofauna is another biological indicator of soil quality that intervenes in the processes of decomposition of organic matter, acceleration and recycling of nutrients and, in particular, in the mineralization of phosphorus and nitrogen. Many of the groups that comprise it are sensitive to natural and anthropogenic disturbances of the environment, which cause changes in their specific composition and abundance, and cause the loss of species and their diversity, with the consequent decrease in stability and diversity fertility [4].

The microarthropods of the edaphic mesofauna participate in ecosystem processes that determine the properties and functioning of the soil, precisely due to the ecological function they perform and their sensitivity to environmental disturbances, suggest that many of the groups that make up the mesofauna are considered bioindicators of stability. and fertility of the edaphic medium. More, however, despite the ecological and economic importance of the faunal groups that make up the soil mesofauna at the time of carrying out agricultural and livestock activities, it is not taken in consideration, and work is rarely carried out for its conservation [5].

Organisms called edaphic arthropodofauna reflect the conditions of the vegetation and the state of soil functioning and, therefore, their study is useful as a tool for evaluating the sustainability of cultivated soils. Oribatid mites and springtail hexapods (mesofauna); beetles and spiders (macrofauna) are permanent, abundant and diverse groups in these systems. They are essential organisms for the functioning of the soil because they regulate and participate in different stages of the decomposition process. When research is carried out and a poor record of mesofauna is obtained, this may indicate that it constitutes a weak link in the soil food chain, due to the disruptive effects of conventional management practices or the poor implementation of agroecological practices [ 6].

The objective of this work is to analyze updated information on research that addresses the role of the mesofauna in relation to soil quality.

## METHODOLOGY

A search, compilation and analysis of scientific articles published in English, Portuguese and Spanish of the last decade was carried out. All the information was taken from the internet in the search engine "Google academic," Dialnet, Wiley Online Library and Pub Med. For the development those articles with the greatest investigative impact were selected.

For the analysis and identification of the main implications of organisms, functions in the soil, relationship with plants, activity carried out on organic matter, decomposition processes and biological indicator, factors that affect the soil mesofauna, and that benefit the soil mesofauna, A staggered compilation was carried out in order to know and analyze all the information relevant on mesofauna. Thus, in the virtual library of the University of Pamplona, the terms “mesofauna” and “soil biology” were introduced, selecting different scientific researches that allowed putting together the entire article.

Using the same search criteria, a compilation and analysis of articles on the influence of soil mesofauna on soil and crop management systems was carried out with national and international research from different scientific journals. The search was completed with an analysis of the information: research years, place of investigation, effects on the mesofauna on forests, crop plantations, green manures and different managements considered. This allowed to know the different points of view that different authors raise in what they coincide and disagree, in order to get different conclusions.

### Main organisms of the mesofauna

In the central-southern zone of Chile, a study was carried out that consisted of censusing and taxonomically and trophically classifying the edaphic mesofauna community of arthropods present in agricultural systems. The mesofaunistic community reached a total of 1,510 individuals, mainly Acari (68.5%), Collembola (28.1%) and other groups (3.4%), of which 78.5% corresponded to decomposers and 21 .2% to predators while it was not possible to determine 0.3%. The abundance was classified in 102 species classified in 43 Recognizable Taxonomic Units (RTU) represented mainly by Acari with 59 species (57.8%), Collembola with 30 species (29.4%) and other 13 species (12.7%) of which 81 species (79.4%) corresponded to decomposers and 18 species (17.6%) to predators while 3 species (2.9%) we cannot determine. This type of studies of relevance of the edaphic mesofauna of arthropodsis essential for this very diverse and understudied group due to its potential role as bioindicators. [7].

Among the soil organisms, Collembola and the mites were part of the most abundant groups, being considered part of the mesofauna. Mites especially stand out for being one of the groups that is not only more abundant (reaching up to 85% of the soil's invertebrate fauna) but also diverse, so to understand this complex litter-soil system it is necessary to study this large group. These are characterized by the variety of trophic levels they occupy, the multiplicity of reproductive strategies they present and the multiple forms of distribution they have. The contribution in the processes that occur in the soil should be highlighted, because it involves the biological control of fungi and other organisms of the mesofauna, important in the decomposition and mineralization of organic matter [8].

The Spatial Independence Scale of the edaphic mesofauna was evaluated in a forest-grassland transect of the "Francisco Javier Clavijero" Botanical Garden in Mexico. The purpose was to carry out an initial study to explore the mesofaunistic composition in a grassland-forest gradient and establish the optimal distance that guarantees spatial independence. They found a total of 3349 individuals (1340 individuals/m2), 1008 individuals in grasslands (1008 individuals/m2) and 2341 in forest (1561 individuals/m2). These individuals were separated into 29 taxonomic groups, of which 15 were selected for geostatistical study. Of the chosen groups, Acari was the predominant group in all the samples with 1099 individuals (33% of the total, 440 individuals/m2), followed by Collembola with 515 individuals (19%, 206 individuals/m2) [9].

Among the mesofauna, oribatid mites and springtails are the most abundant arthropods with the greatest specific diversity in the soil, they are constant, abundant and diverse groups in edaphic systems. They are essential for the functioning of the soil since they regulate and participate in different stages of the decomposition process. Through their activity, they fragment and transform organic remains into waste available for mineralizers, disperse other organisms such as bacteria and fungi, affecting growth, specific composition and reproduction. Several authors have pointed out its sensitivity to some agricultural practices, which is manifested in the reduction of its abundance, its diversity and the simplification of its structures [10].

Springtails participate in a wide variety of ecosystem services related to plant nutrient availability, water storage and regulation, soil stability, and moisture and pH control necessary for soil fertility. For this reason, epiedaphic springtails are considered as organism's sensitive to changes generated in land use [11].

Mesofauna members include soil mites, springtails, prothurs, diplures, Psocoptera, Thysanoptera or thrips, pauropods, Symphyla and enchytreids [12]. The edaphic mesofauna is more abundant and diverse, with mites and springtails being the most important due to their abundance, diversity and function in the soil, in addition to being ecological indicators due to their great aptitude for speciation, short life cycles and little dispersion of the species [13].

Oribatid mites are a fundamental part of the mesofauna, they are involved in the proper functioning of edaphic ecosystems, however, they also usually inhabit tree strata where their specific composition is usually very different from that found in the soil or litter [14].

In the same way, it coincides with the investigation of the variation of the mesofauna in different agroecological methods where a total of 1,915 individuals of the phylum Arthropoda were collected, represented by two subphylum, three classes, two subclasses, six orders and two families. In particular, the Arachnida subclass was represented by four orders: Oribatida, Astigmada, Mesostigmada, and Prostigmada; for its part, the order Mesostigmada included the families Gamasidae and Uropodidae [15].

Authors have estimated the populations of mesofauna to determine the changes in populations of mites and springtails in a soil with and without the application of green manure and sown with corn *Zea mays* L., and respective results confirm that the most representative groups were the mites, springtails, ants, Hemiptera and Coleoptera [16] [17].

The oribatida and uropodinos, as detritivorous groups, and the gamasinos, as predatory organisms, all susceptible to the quality of organic matter and humidity, therefore, indicators of fertility and stability of the edaphic environment, these are an order of mites very dominant in organic soil horizons and can reach population densities of hundreds of thousands of individuals per square meter [18].

Oribatid mites are the most representative group in the soil mesofauna. These organisms are part of all ecosystems. Oribatida are soil dwellers and have been little used for biogeographical analyses, research has been carried out on the biology and ecology of these mites. These organisms are of great importance because they contribute to the degradation processes of organic matter, the incorporation of humus nutrients in the soil, and are used as bioindicators of soil quality [19].

The diversity of the edaphic mesofauna in three land uses in the Mayabeque province of Cuba was studied.

The systems studied were: silvopastoral system, secondary forest and cultivated grassland. 399 edaphic microinvertebrates belonging to two classes, five orders and 19 families were collected, the dominant family was Uropodidae, which is reported as a group of detritivorous mites, with morphological and bioecological characteristics that make them very demanding in terms of habitat quality. It is concluded that the secondary forest and the silvopastoral system enable the recolonization of the edaphic communities and the conservation of their function; In addition, systems with trees contribute to the conservation of the biological quality of soil properties [20].

**Ground functions**

It has been shown that, in tropical systems, the mesofauna plays an important role in the processes that determine the conservation and fertility of the soil, the regulation of the availability of minerals assimilable by plants and the structure of the soil, influencing the conditions of life, abundance and composition of other soil communities in general [21].

The edaphic mesofauna of arthropods is responsible for the mechanical fragmentation and distribution of decomposing plant material in the soil profile, structuring and influences microbial activity, which regulates biological and chemical conditions in the soil. It fulfills very important functions in edaphic processes (nutrient cycling, trophic networks, etc.), and it responds to anthropogenic alterations and environmental factors [22].

A positive relationship was found between springtails and soil moisture. It was recorded that some of the springtail populations are distributed vertically in the soil profile in response to a moisture pattern, which is attributed to a close relationship with the establishment of fungi and bacteria, food sources for many of them [23].

The microarthropods of the edaphic mesofauna (MME) integrate ecosystem processes that determine the properties and functioning of the soil. Within this, the mesofauna plays a key role in the functioning of the edaphic ecosystem by occupying all the trophic levels of the soil food chain and affects primary production directly and indirectly [24].

Knowing the functions of the mesofauna or the variation in abundance, between the wet and dry seasons of a specific area, is important when using these sites as a reference for future evaluations of soil degradation through bioindicators, the importance function of the edaphic mesofauna because it is present at all trophic levels of the soil food chain and affects primary production directly and indirectly, the records of the greatest abundance of mesofauna are in most cases the winter periods and in the wetter seasons [25].

**Benefits in plants**

Among the benefits of the mesofauna to plants is the regulation of the availability of minerals assimilable by plants and the structure of the soil [26]. Some organisms of the mesofauna such as *Orchesella bifasciata* (Entomobrydae: Collembola) act as a biological controller of various species of fungi that affect plants, such as *Cladosporium* sp., *Phoma* sp., *Fusarium* sp., *Fusarium oxysporum*, *Phomopsis* sp., *Helminthosporium* sp., *Alternaria alternata*, *Trichoderma* sp. and *Aspergillus* sp. It is a very important practice for pest management, which consists of the use of living organisms to reduce and maintain the population abundance of a pest below the levels of economic damage [27].

Between the main forms of humus there are transitions where various types of decomposition occur by members of the mesofauna. A frequent type of humus is determined by the mesofauna, improving the physical properties of the soil, greater moisture retention and aeration capacity, therefore improving permeability, in the same way it improves the capacity of sandy soils and some clay soils, keeping them spongier, this matter organic material degraded in its final state due to the effect of soil-dwelling organisms that are chemically stabilized and therefore regulate the dynamics of plant nutrition [28].

The edaphic mesofauna has been proposed as an indicator of soil quality, both a particular species and communities and their biological processes. The groups of edaphic mites have different responses to the management applied to it: while the Oribatida are more susceptible to management practices, while Astigmata and Prostigmata can be very numerous in agricultural systems since their populations are benefited as a result of the anthropic activity [29].

**Activity carried out by the mesofauna in organic matter, decomposition processes and biological indicator**

The edaphic mesofauna: is considered a biological indicator of soil quality that intervenes in the processes of decomposition of organic matter, acceleration and recycling of nutrients and, in particular, in the mineralization of phosphorus and nitrogen. Many of the groups that comprise it are sensitive to natural and anthropogenic disturbances of the environment, which cause changes in their specific composition and abundance, and cause the loss of species and their diversity, with the consequent decrease in stability and diversity. fertility [30].

The edaphic mesofauna of arthropods is taken in consideration as an important component of the ecosystem due to its relevant role as a catalyst of microbiological activity for the decomposition of organic matter, recycling of nutrients, soil moisture, mechanical fragmentation of decomposing plant material [31].

The mesofauna intervenes directly in the cycles and processes of fragmentation and redistribution of organic waste produced by plants, facilitating the decomposition of organic matter and the availability of nutrients in the root zone, as well as the acceleration of the recycling of nutrients and the mineralization of phosphorus and nitrogen, which leads to guarantee the maintenance of edaphic productivity [32]. The edaphic mesofauna performs essential functions in the soil such as the recycling of nutrients and the formation of its microstructure. The richness and abundance of the edaphic mesofauna in grassland agroecosystems is low and highly, variable in various climatic periods. Individuals belonging to the trophic categories of predators and detritivores have been found, which showed a variable relative abundance, in each agroecosystem [33].

The presence of some groups of the mesofauna associated with the highest content of organic matter in the soil, fundamentally total organic carbon and water-soluble carbon, demonstrates the importance of their function in the decomposition and recycling of nutrients, in the same way, pH, organic carbon, total nitrogen, and other nutrients can influence soil mesofauna communities [34].

The mesofauna plays a key role in the functioning of the ecosystem, due to the fact that they contribute to many soil processes, these intervene in the processes of decomposition of organic matter, acceleration and recycling of nutrients, in the mineralization of essential elements and the regulation of the biotic communities inside or outside the soil, in addition, they also regulate the trophic processes of the edaphic environment, by contributing to the formation of its microstructure with its contributions of excretions, secretions and with its own corpses, making mineralization faster, especially of nitrogen, phosphorus and nutrient recycling [35].

The edaphic mesofauna stands out for its use as a biological indicator, an obvious example is that some nematodes, due to their ubiquity, their taxonomic and functional diversity and their great abundance in edaphic systems, soil degradation causes a decrease in the biodiversity of the edaphic mesofauna causing desertification, decreasing the upper layer of the soil, therefore the content of organic matter, the native vegetation and the litter inhabits the main of these organisms [36].

**Factors that affect the edaphic mesofauna**

The mesofauna, on the other hand, is very sensitive to climatic changes and anthropogenic disturbances of the edaphic environment, which cause variations in its density and diversity [37]. For this reason, soil meso-invertebrates are increasingly included in environmental monitoring and evaluation, as reliable indicators of ecological change, due to their abundance, diversity, ease of collection, rapid response to environmental disturbances, and their role functional [38]- [39].

Biomass exploitations carried out by harvesting dry corn sown in a traditional way or alone, can alter, to a certain extent, the cycle of nutrients required by the component populations of the area's mesofauna, negatively influencing the behavior of the indices. ecological values of the arthropod communities of the mesofauna, reflecting in lower records of these indices after harvest in this case (maize monoculture) [40].

On the other hand, changes in land use affect the composition of the soil (mesofauna) and affect its productivity. However, agroforestry practices could mitigate the negative impacts of production on local ecosystems. In an investigation, it shows that plots without yerba mate cultivation had a greater abundance of mesofauna and higher diversity indices. Thus, the content of organic matter was higher in forests without yerba mate cultivation, while the weight of litter was higher in forests with yerba mate cultivation (associated cultivation) [41]. That is why the use of land associated with agricultural and/or livestock activity is one of the key factors that affects soil biodiversity, with negative impacts on the physical, chemical and biological properties of the soil, which causes a general decrease or loss total of it [42].

In other investigations carried out, some disturbances caused by changes in land use were determined, such as the conversion of forest to pasture, which could modify the composition of the mesofauna and affect the probability of recovery of the original ecosystem, therefore causing the loss of biodiversity. Associated with the transformation of natural ecosystems to cultivation, modifying the flow of nutrients and energy that require human intervention to maintain the productive functionality of the system [43].

It is reported that the edaphic mesofauna is sensitive to natural and anthropogenic disturbances in the environment, producing changes in its specific composition and abundance. This allows it to be selected as an indicator of the disturbances generated in the stability of the ecosystem by land use [44].

Some plant species such as *Eucalyptus* can be seen favored by the absorption capacity thanks to the dense root system that it presents, which leads to a reduction in the availability of water and nutrients from the soil, not only reduces its fertility, but also its competition by water supposes a reduction in both floristic diversity and that of other plant species, which translates into an impoverishment or reduction of the edaphic mesofauna, which is largely responsible for recycling organic matter and, therefore, for soil fertility [45].

The biodiversity of the organisms of the mesofauna decreases inversely to the intensity in which the plants are cultivated through mechanized and agrochemical methods in the transformation of natural ecosystems into agricultural systems, producing a negative impact on communities and the physical structure of the soil where negative changes are caused in the composition and physical structure of the mesofauna that inhabits it, as well as, in the functioning of this resource and the ecosystem in general, the intensive use of the soil in the agricultural exploitation causes the reduction of agroforestry and silvopastoral systems are widely recommended since these offer environmental services, such as allelopathies, protection of pollinators and biological control of pests. Moreover, improvements in the biology of the soil that benefits the nutrition of plants and therefore makes them sustainable and resilient to climate change [46].

Soil degradation directly negatively affects the organisms that inhabit it, which can be classified as: mesofauna (arthropods and nematodes) [47].

**Factors that benefit the soil mesofauna**

It has been shown that agroecological practices in grassland and forage areas contributed positively to the total abundance and to that of the different edaphic microarthropods that compose it, during the two seasons of the year, such a result demonstrates the influence of greater stability in management, of the density of roots and the direct contribution of excrement generated by cattle in these areas, which served as stimulation in the establishment of the mesofauna [48].

Unlike other authors who suggest that soils with native vegetation are very diverse in mesofauna groups, which suggests a greater complement of groups and ecological functions compared to soils with sugar cane and grasses, Soils with native vegetation they also maintained a higher abundance of predators such as spiders, scorpions, and centipedes. Ants and earthworms were the most abundant groups in the native vegetation, this diversity is due to the large amount of litter accumulated in the upper soil layer [49].

According to some authors, the establishment of some plants such as buttercup or false sunflower (*Tithonia diversifolia*) can increase the mesofauna in the soil and also has potential for the recovery of degraded soils, adaptation to different climatic conditions, which is a positive aspect [50].

It agrees with the test carried out by [51]. which proves that the relative abundance of cellulolytic microorganisms, considered colonizers of organic debris, is significantly higher than the rest, which suggests that sustained agroecological management will increase the content of organic matter in the soil. In sites with agroecological production but that still use plowshares, when plant debris remains on the surface, the soil mesofauna increases.

The succession of crops leaving stubble on the surface and eliminating the mechanical manipulation of the soil (zero tillage) reduces erosion to a minimum, produces an increase in organic matter, basically due to the process of death and decomposition of the roots and the protection it generates. the dead plant cover on the surface that is integrated into it, increases the life of the mesofauna, in turn improves the structure of the soil; However, in the site where a more conservationist cleaning system is applied (partial removal of undergrowth), a greater abundance of mesofauna and organic matter content were found in the forest with yerba mate cultivation [52].

The variation of the components of the edaphic mesofauna in a farm with agroecological management was evaluated from the application of agroecological methods, a study was carried out in a farm with more than 20 years of establishment in the Artemisa province (Cuba), distinguished by a high dominance of detritivorous microarthropods. No dominant taxa were present in the polyculture area. It is concluded that the behavior of the edaphic mesofauna was highly dependent on the type of soil management and seasonality (Socarrás-Rivero & L. Izquierdo-Brito 2016). [53].

According to authors, when comparing the populations of arthropods, of the mesofauna, due to the contributions of green mass, it is fundamentally achieved with the double incorporation of the crotalaria plant, a great abundance of mesofauna, therefore, it maintains an adequate content of organic matter (OM) in the soil on which the populations of the main indicator taxa of good biological quality of the soil depend, in particular mites, springtails, beetles and proturs among others. On the other hand, organic matter is fundamental for the edaphic fauna, in addition to the fact that the biodiversity indices are related to the content that is present in the soil [54].

**Influence on soil and crop management systems**

Determines soil mesofauna diversity in response to agroherbicide toxicity in the Niger Delta rainforest zone, Nigeria. Specifically, the diversity of the soil mesofauna (mites and springtails) was studied under the effects of the applications of two herbicides (atrazine and paraquat). Specific and synergistic toxic manifestations of herbicides are discussed in relation to concern for soil arthropod biodiversity versus large-scale agricultural pesticide applications to boost food security and the challenge of achieving the global goal of green economy [55].

A study about the effect of the mesofauna on the decomposition of tree leaves, collected every 2 weeks before natural fall was developed for 367 days. The three-year-old tree plantations *Elaeagnus angustifolia* L., *Ulmus pumila* L. and *Populus euphratica* Oliv. were present. According to the results, the proportions of mesofauna degrade the leaves of *Elaeagnus angustifolia* L. more easily and it is an additional criterion for the afforestation of degraded and irrigated farmland in the study area [56].

Detected the influence of elevated $CO_2$ levels and transgenic barley on a soil mesofauna community in a meso cosmos test system, the combined effect of increased atmospheric carbon dioxide ($CO_2$) levels and increased crop use genetically modified (GM) maize litter acted as a food source for the community, in microarthropods, indicating a shift in the diet of the Collembola species towards carbon derived from barley, due to the decomposition of maize litter [57].

An evaluation on the effects of current agricultural sequences on the soil mesofauna after 12 years was make. In the trial, 5 agricultural sequences were proposed: 1.- Conservationist Agricultural System, 2.- Mixed: rotation with pastures, 3.- Winter agricultural, 4.- Mixed: traditional with greening, and 5.- Intensive agricultural. On the other hand, in the 10-20 cm stratum, 516 individuals were collected, of which 93.9% were annelids. The effect of the sequences was significant for Collembola in the 10-20 cm stratum, where sequence 2 presented greater abundance than those other sequences. In the 0-10 cm stratum there were no differences. The soil mesofauna consisted mainly of enchytreids and springtails [58].

It was determined the existence of changes in the structure of the edaphic mesofauna associated with two intensities of land use. They worked with samples of mesofauna associated with the litter of two argiudoll soils with different intensity of use. The results showed that the structure of the edaphic community between the contrasted systems differs in richness, composition and diversity, and that the latter varies according to the date. sampling [59].

It was analyzed the taxocenotic and biocenotic similarities, over time, of the edaphic mesofaunistic taxa in a blueberry plantation (*Vaccinium* sp.), subjected to organic management practices in farms in the south-central zone of Chile. There was a great taxocenotic similarity in the time in the edaphic community structure of *Vaccinium* sp. Fourteen taxa made up the edaphic taxocenosis of the mesofauna, with Acaridida, Oribatida and Entomobryomorpha being the most abundant. There were significant differences between the diversity (H') of mesofauna taxa in organic plantations with a year of transition to organic management [60].

It was studied the edaphic mesofauna of the high montane evergreen forest, located in the Jubayacu river micro-basin, Achupallas parish, Alausí canton, Chimborazo province. A total of 1704 individuals were detected, belonging to 7 families, 16 orders distributed in 7 classes. The density of the species reported values of 28,000 to 39,400 individuals/m$^2$. Shanon's biodiversity index presented a high value in all clusters, while Simpson's index showed a medium diversity in transect 1 and 5; a high diversity in the other transects, the value of importance showed a wide distribution for the order Isopoda in transects 1-4 and in transect 5 the order Spirobolida was found, which directly depended on the state of forest conservation [61].

Some researchers estimated changes in mesofauna populations (with emphasis on mites and springtails) and in some of their physical properties caused by the use of green manures (AV). Mites and springtails were the dominant populations within the soil mesofauna. The cutting and addition of AV and compost increased their populations, being the Oribátida and Mesostigmata mites and the Entomobryidae and Isotomidae springtails the most abundant. Bulk density, aggregate stability, mites and springtails showed sensitivity to changes introduced in the maize system by the use of green manures and compost [62].

They evaluated the functional groups of the edaphic mesofauna, in coffee production systems (Coffea arabica L), under conventional management and in transition. The Methodology consisted of a random sampling stratified by mesofauna system. Simultaneously, the results show the greater abundance and functional composition in the order Transition II (Use of organic inputs) Transition I (Rationalization of synthetic inputs sustainable production systems than in conventional ones [63].

## CONCLUSIONS

- The investigations carried out are based on: diversity of the mesofauna in the soil, effect of the mesofauna on organic matter, mesofauna in different types of soils, behavior of the mesofauna against $CO_2$ levels, variation of the mesofauna in agroecological farms or with polycultures, in forests, the effect of the different agricultural operations on the mesofauna such as pastures, mixes and crops, changes in soil structure due to intensity in land use, characterization of the mesofauna.
- Among the main soil organisms, it was found that Collembola, myrapods and mites that belong to the orders Crytostigmata, Prostigmata, Mesostigmata and Astigmata are part of the most abundant groups.
- The mesofauna plays an important role in the processes that determine the conservation and fertility of the soil, the regulation of the availability of minerals assimilable by plants, so the contributions of the mesofauna in plants through the decomposition of organic matter increases the area of action of microorganisms that decompose plant residues.
- The mesofauna is favored by agroecological practices such as the association of crops, plant covers and the incorporation of crop residues, use of organic inputs, green manures and compost, implementation of easily degraded plants, zero tillage and avoiding soils. discovered.
- The edaphic mesofauna is affected mainly by the exploitation of a single plant species with high applications of agrochemicals, climatic changes, anthropic disturbances of the edaphic environment, changes in land use, soils without cover, livestock overexploitation, plantations such as eucalyptus decreases the fertility and humidity of the soil, in turn the mesofauna reduces the populations, mechanized soil preparation and edaphic degradation.

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