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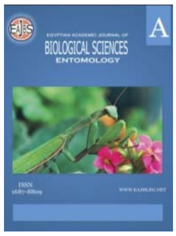

A Review Article :

The Effect of Agricultural Practices on The Abundance and Biodiversity of Soil Fauna

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REVIEW ARTICLE

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ABSTRACT

In this review, we summarize recent researches on the effects of agricultural practices on the abundance and biodiversity of arthropod soil fauna with special reference to spiders. This article examines the detrimental effects of such of these practices intensification and considers agriculture practices which aim to protect soil fauna from decline. Modern agricultural practices, including tillage and intensive use of conventional insecticides, have been broadly linked to the declines in biodiversity in agro-ecosystems. The organic farming, soil solarization, intercropping, poly-culture, mono-culture, crop rotation and fertilizer, are also discussed. Biodiversity refers to diversity of genera ,species and ecosystems. Also we discuss the best way to apply sustainable agriculture which increase population density of soil fauna and conserve biodiversity.

INTRODUCTION

Agricultural practices can be both beneficial and detrimental to the soil biota. Likewise soil biota increase or reduce agricultural production (Gupta, 1994). Population size and species diversity of soil fauna are strongly influenced by agricultural practices (Wallwork, 1976 ; Pong, 2013). Practices that adversely affect the soil fauna include mechanized land cleaning and ploughing (Roberts and All 1993a; Bigler *et al.* 1995b) monoculture (Altieri *et al.* 1987; Bigler *et al.* 1995a and Lee 1995) and indiscriminate use of agrochemicals (Roberts and All 1993a ;Lee 1995;Bigler *et al.* 1995a ; Smart *et al.* 1995).

On the other hand, soil and crop management techniques that favor and enhance the activity of soil fauna include mulch farming (Roberts and All 1993a; Mupangwa 2007; Brevault *et al.* 2007and Dahiya *et al.* 2007), no-tillage (Rizk and Mikhail 1999;Mupangwa 2007; Tabaglio 2008, and Mutema *et al.* 2013). Cover crops (Roberts and All 1993a, 1993b, Buntin *et al.* 1994), agro forestry and other ecologically compatible farming system (Altiri *et al.* 1987, Lee 1995, Bigler *et al.* 1995a).

Soil organisms range in size from microscopic e.g. bacteria to several centimeters e.g. earthworms (Mutema *et al*. 2013).The activity of soil biota is concentrated in the top 10cm of soil (Gupta and Germida 1988).

Resistance to extreme changes in the soil environment increases as organisms decrease in size. Soil with high levels of organic matter support a greater number and more divers of biota. The rate of organic matter breakdown relates to the soil environment, the number and type of organisms present and chemical structure of the plant residues. Breakdown may occur in months or several thousand years. The conversion of organic matter by soil organisms, to available nutrients is called mineralization. This process is a key element of soil fertility.

Soil organisms can act as bio-filters by cleaning soil pollutants. Toxic elements, e.g. arsenic, chromium and mercury, can be "locked" in the soil by microbial activity, preventing further pollution. This process is dependent on soil type (Gupta 1994). Soil structure and soil biota are inter dependent. The mucus coverings of soil biota mix with the soil and helps sticks the particles together forming soil aggregates. Well aggregated soil provides a better living environment for soil organisms and support larger populations (Gupta 1994).

Movement of organisms, e.g. earthworms and arthropods through the soil improves the structure by mixing and aerating the soil. This also increases water infiltration rate(Gupta and Germida 1988).

Agricultural Practices Methods:

1- Tillage, No Tillage, Cover crops:

Cultivation alerts the physical, chemical and biological components of the soil system. No-till, direct-drill systems result in significant differences in soil organisms activity compared to conventional deeper tillage. Rizk and Mikhail (1999) found that higher activity densities of soil fauna taxa were generally associated with no-tillage practices, this result conformed by (Altieri *et al.* 1987; Emmanouel *et al* 1991;Maia *et al.* 1991; Roberts and All 1993a; Nelson *et al.* 1994; Smart *et al.* 1995and Wardle *et al*.2006).

The cover crops favor and enhance the activity of the soil fauna (Hammond 1990; Buntin *et al.* 1994). Rizk andMikhail (1999) indicated that, which the cover crops of *Lupinus termis* and *Triflum alexandrinum* before incorporation into the soil, supported higher activity densities and more groups (4 taxonomic groups) of soil fauna than in the case of tomato cultivated with conventional tillage practices (2 taxonomic groups). Also, indicated that soil and crop management technique that favor and enhance the activity density as well as the diversity of the soil fauna are no-tillage, cover crops and crop residues.

Gupta(1994) indicated that, conventional tillage allow, organisms to distribute more deeply into the ploughed layer. Residue decomposition and nutrient mineralization is more rapid due to better soil stubble contact. The rapid activity results in a higher level of breakdown and lower level of organisms matter accumulation. Earthworm population significantly decreases (Wardle *et al*.2006).

According to Wallwork (1976) in this case, the soil fauna especially mites and collembola were influenced by crop and ploughing due to the removal of many surface-dwelling insects and this interpret the fluctuation in collembola numbers. Annual plowing results in a reduced spider diversity (Haskins and Shaddy, 1986).

2- Crop Rotation :

Crop rotation is a planned order of specific crops planted on the same field. Some of the general purposes of rotation are to improve or maintain soil fertility, reduce erosion, reduce the build-up of pests, spread the work loat, reduce risk of weather damage, reduce reliance on agricultural chemicals, and increase net profits (Michael 1998).

Crop rotations are fundamental to sustainable cropping systems. As well as designed crop creates diversity and improves soil condition, also generate biodiversity of soil fauna and soil fertility, (Rizk *et al.* 2006). Crop phases in the rotation are used to improve the biological activity of soil (Clapperton and Ryan ,2002). Gupta (1998), indicated that crop residues form micro-sites of large and diverse populations of soil micro organisms and the quality of crop residue (e.g. C / N ratio) affects the types of soil biota it support. Rizk *et al.* (2006) found that rotation of tomato plant after medicinal and aromatic plants play an essential role in break herbivores in tomato also can provide the basis for effective none-chemical. Medicinal plants possess active ingredients use mainly in preventing or curing aliments. They may and usually have other properties with permit them to be used as a botanical insecticides, (Chomchalow, 2001).

Rizk *et al.* (2006) found that, the rotary cultivation plots had more soil animals than the medicinal and aromatic plants. The effect of medicinal and aromatic plants on activity density of soil fauna can be related to their continuously secreted oils. These oils, of course, are volatile and quickly dissipated. (Clapperton and Ryan 2002;Gupta 1994) indicated these results, that rotation uses will improve the biological activity of soil biota. Rotations including legumes or pasture crops have a large and more diverse pool of organisms. Cereal residues more support fungi while legume residues support more bacteria. Population of collembola and mites were found to be higher in soils under long term pasture (70000/m^2) compared to soils under wheat-wheat (20000 m^2) or wheat-lupin rotation.

Ghallab *et al.* (2004), found that the activity-density of Diptera increase by rotation was considered as accidental and it was subdominant species. Wallwork (1976) indicated that, ploughing encourage the establishment of populations of various agricultural pest such as dipterosis and coleopterous larva which feed extensively on the roots of all crops. Also Ghallab *et al.* (2004) indicated that, after rotation, herbivores were less abundant in all plots, especially in garlic plant more than spinage and radish. Hill (2004) indicated this result, cultural methods (crop rotation) are essential for the control of soil pests. Gupta (1994) indicated that unlike monocultures, rotations offer a number of advantages to plant production and to the maintenance of soil quality. These include disease break, improvements to plant nutrition, improved levels of organic matter, divers and nutrient sources for the soil biota and benefits for soil structure.

The effect of ploughing crop rotation: investigation of soil fauna in crop cultivation is compared with that after ploughing and rotary cultivation. Ghallab *et al.* (2004), indicated that result as observed that communities of stable environment show high species diversity. This result agree with ,Edwards and Lofty(1969) that crop rotation decreases species diversity to an even greater extent. Emmanuel *et al.* (1991) added that, with rotary cultivation, the superficial mining of manure fertilizer and crop residues yield more favorable living condition.

Ghallab *et al.* (2004), indicated that diversity of soil animals in crop cultivation were mush higher than the rotary cultivation, as well as, increase in the activity-density of some soil animals.

Also Mutema *et al.* (2013) confirmed, that the break crops can reduce number of host specific organisms. This helps reduce numbers of pathogenic organisms. Crops with fibers roots e.g. cereals, are thought to provide more site for microorganism to colonize compared to those with a single tap root and relatively few lateral branches.

3 - Soil Solarization:

A major limitation of this method (Solarization) in its dependency on climate. Soil solarization was used to control root-knot nematodes, soil born diseases and root-rot disease, and provide weed control. Solarization is a method to control soil biota by solar heat and does not involve chemicals or toxic materials. This method is economically and easily implemented in Mediterranean and tropical regions where hot summer occur.

Solarization can have a positive, negative or neutral effect on pest-soil fauna and biological control interaction. It will also affect the densities and distribution pattern of trophic (functional) groups among soil animals (Rizk, 2002). The temperature in solarized plots for each depth was higher than in unsolarized plots.

The important factor affecting results is the extent to which animals are active on the soil surface, soil solarization (Rizk, 2002). The activity of soil fauna may be limited by excessive temperature (Abdel-Hamid 1991) and excessive cold or excessive moisture (Shenishen and Khalil, 1984).

Rizk (2002) found that the activity-density of the soil fauna decreased after solarization from 110 individuals fallow plots to 41 individuals in cultivated plots to 15 individuals in solarized plots. Also, some species disappeared such as Neuroptera (*Chrysopa volgaris)* and Symphyta (*Cephidae* sp.).

Vats and Narula (1993) found that population density of Acarina was positively correlated with temperature. Rizk (2002) found that spiders decreased from 30 individuals in fallow plots to 27 in cultivated plots and only 4 individuals in solarized plots. Warren *et al*. (1987) noted that increased insolation allows some grasshopper nymphs to emerge earlier than usual.

Soil solarization decreased the total number of soil fauna, because soil solarization increased the soil temperature, and this normally decreases the diversity of the soil fauna, particularly species constrained by heat.

Rybalov (1990) found that in the dry season there is gradual decrease of biological activities with some groups passing it in arresting stage and others migrating to more humid habitats. The range of environmental temperature in which this constancy is maintained varies among species and the development stage of each individual (Tahir and Butt, 2009).

All studies indicated that solarization can affect not only pest insects but also all soil fauna, reducing the total number of fauna.

4- **Fertilizers**

Organic and Inorganic Chemical Fertilizers:

The relationship between mineral and their effect on the abundance of arthropods has been taken in consideration in the recent year; heavy metal such as Cupper, Iron, Manganese …etc. appeared to affect plants attacked by pests (Hassiman, 1946), also Zinc and Manganese can be applied as a soil spray prior to seeding, so they enriched fertilizers at seeding, or as a foliar spray (Hawthorne *et al.* 2003).

The application of fertilizers increases the nutrient content of the soil and generally has beneficial effect on the soil fauna, (wallwork,1976). The relationship between soil fauna and different fertilizer management practices is of growing concern.

Fermenting microorganism can break down organic matter and the production of beneficial organic acid such as amino acids, bioactive substance and vitamins promotes photosynthesis and increase the microbial diversity of soils, supply nutrients to crops and enhances plant vigor, growth, and yield and quality of crops.

Collembola, their abundance serves as good indicators of soil health. Fountain and Hopkin (2004) showed that collembolan (Springtails) are abundant and widespread in soil ecosystems and are important members of the decomposer community. Also Koehler (1992), indicated that soil mesofauna (mites, millipedes and collembolan) are sensitive to agricultural chemical inputs and as result, may also have potential as biological indicators of chemical impact on the ecosystem. Ghallab *et al.* (2007) show that there are less collembolan in the micro-elements treatment than biological fertilizers produces (EM: biological fertilizers produced) and other. Also, Fountain and Hopken (2004) have found that species richness of collembolans decreased with the increasing of metal contamination. Also, (Steiner ,1995and Naeem *et al.* 1994) reported the same result.

In general, rates and numbers of individuals from mites and insects belonging to various families were higher in the organic cropping system (Bettiol *et al.* 2002). Wallwork (1976) concluded that plot treatments with organic matter permitted dipterous larvae established in greater densities than in untreated plots. Ghallab *et al.* (2007) are in agreement with this result which plot of (EM: biological fertilizers produced)) treatment revealed the highest total numbers of maggots.

Enami (2000) studied the effect of organic matter application and the inorganic chemical fertilizers on the soil fauna he stated that species diversity of oribatid mites was higher in plots with surface covering of organic residues while it was lower in successive application of the inorganic chemical fertilizers.

Ghallab *et al.* (2007) and Scialabba (2007) revealed that organic management, increases the abundance and species richness of beneficial arthropods living above ground as compared to the inorganic and untreated plots, also some predators such as the true spiders tend to exist in high numbers. Rizk *et al.* (2008) are in agreement, with these results which found that the organic forming systems could potentially sustain larger or more diverse spider communities than intensive forming systems because of absence of agrochemicals. Rizk and Mikhail (2000a), showed that the soil treated with agrispone (organic compound), reduced the numbers of herbivores (pests) and created conditions suitable for detritivores to become abundant and open the way for predators to eat the pests.

Also, Scialabba (2007) indicated that the organic agriculture significantly increase the density and species richness of indigenous invertebrates, specialized endangered soil (species, beneficial arthropods, earthworms symbionts and microbs). Moreover, Enami (2000) indicated that species diversity of oribatid mites was high in the plots with surface covering by organic residue, while being lower in the successive application of chemical fertilizers.

Rizk *et al.* (2008) found that (EM: biological fertilizers produced) treatment had the higher diversity index while the Trce -Elements treatment had the lowest. So, the values calculated for each treatment described the different species diversity index. This result is also indicated by Feber *et al.* (1998), who proved that both the number of spiders captured and the species richness of spider samples were higher in organic wheat field than conventional one. These observations suggest that the habitat differences which are associated with these systems have measurable impact on the spider communities. So, all species of spider are sensitive to changes in different type of fertilizers.

5- Chemical insecticides; Bio-pesticides; Acaricides:

Insecticides, probably the most widely used pesticides in many areas, are much more variable in their effects on soil fauna than are herbicides or fumigants, Zedan *et al*. (1993). The use of several pesticides has become common nowadays to obtain high agricultural yields from land (Ghabbour and Ayyad, 1990).Pesticides may persist in the soil, pass along food chains, and eventually be assimilated in harmful or lethal concentrations into the bodies of vertebrates, and particularly humans. However, it is essential to maintain a healthy community of soil organisms, soil fauna which perform an important role in the decomposition of fresh plant parts, and maintain soil fertility (Ghabbour and Ayaad, 1990).

The use of pesticides will not only decrease pest insects but also the predators that feed upon them (Winston, 1997). Pesticides affect arthropods either directly via contamination or reduction of their prey, or through alterations of the micro-habitat. The reproduction rate may be reduced by sub lethal long-term effects of synthetic pesticides used in conventional agriculture.

Although large quantities of insecticides are applied to crops, only a small percentage of the quantities applied reaches the target pests. Thus more than 99% of the applied pesticides may go off into the environment and affect non-target sectors of the ecosystem including soil, water, atmosphere and the non-target biota (Mikhail *et al*. 1995; Rizk *et al*. 2004; Rizk *et al*. 2005).

On the other hand, the longer chemical remains in the environment, the greater the chance that it will have adverse effects, and the greater the likelihood that it will spread or be transported from the treated crop ecosystem to other ecosystems (Mikhail *et al*. 1995). Also, the pesticide may accumulate in the environment if the staying life of the chemical is greater than the frequency of application. Wallwork (1976) stated that Millipedes, root-feeding aphids, Diptera, Coleoptera larvae and mesostigmatid mites were, in general, adversely effected and population sizes decreased with each application of the pesticide, but collembola and enchytraeids showed significant increases in sprayed plots. Mikhail *et al*. (1995) indicated that application of bio- pesticides and insecticides affect to a great extent the composition of soil taxa. The relative toxicity of pesticides to pests, predators and immature stages of the predators should provide an adequate indictor for selectivity of pesticides, which is essential for development of pest management programs (Jeppson *et al*. 1975).

Many previous studies have shown that the type of vegetation cover as well as chemical conditions in the soil affect reproduction survival and the abundance of collembola (Pflug and Walters, 2000; Ponge *et al*., 2003; Menta *et al*., 2006; Syrek *et al*. 2006).

Huusela-Veistola *et al*. (1994) studied the effect of insecticides treatment on soil arthropods. They founds that the epigeal Arachnida and Collembola were more numerous in pitfall trap samples taken from control plots than in insecticides-treated plots immediately after treatment. Ant populations were found to be an indicator species as to richness of other soil invertebrates (Bonnie, 2004).

Also, Mikhail *et al*. (1995) indicated that, Collembola and Diptera could withstand the effect of different biocides treatment and showed slight increase in their number by the end of the study period. Ploughing or rotation may only change the balance of the soil fauna or flora for a matter of weeks or at most months, persistent chemicals can alter them for months or years (Edwards 1965, Edwards & Thompson 1973).The main differenceis that the effect of chemicals lasts longer (Hill, 1977).

Zedan *et al*. (1993) found that the recovery of soil fauna population in cotton field after consecutive application of Dursban, Tamaron, Compene and Sevin, was limited only to spiders, Collembola and *Monomorium sp*. (Formicidae), and occurred two months after the last application of insecticides.

Ghabbour and Ayyad (1990) found that rates of loss of such pesticides after 90 days of application were higher in sandy and dry soils than in clay and wet soil , also a rise in temperature will cause an acceleration in the loss of these pesticides. Ghabbour and Ayyad (1990) found that, all tested insecticides decreased predaceous mites under all treatments, some being completely eradicated in some cases. While, in some other cases their numbers were reduced by 80% for several weeks. Total mites were also reduced, especially under cotton plants. Oribatid mites, Collembola and total insects were equally decreased. The fauna could therefore be used as early indicators of changes brought about in soil properties by pollutants (Paoletti *et al.*1991).

Some previous studies examined the effects of some acaricides on non-targert soil fauna and beneficial species such as spiders (Kim&Yoo 2002; Rizk *et al*. 2004&2005).

Rizk *et al*. (2005) found that activity-densities of soil fauna were reduced after application by different types of acaricides. The reduction was limited to Collembola, spiders, Diptera and Hymenoptera (Family, Brachonidae). But, Rizk *et al*. (2004) reported of the dangers for using these acaricides on the biodiversity of the true spiders fauna. Also, Rizk *et al*. (2005) supported these results, which found that Hymenoptera less effected with acaricides.

Moreover, applications of different synthetic acaricides affected to a great extent the functional (trophic) groups of soil fauna. Rizk *et al*. (2004) found that Akoafol treatments were more effect on the reduction of the numbers occur of true spiders, and after 21 days they can not recovery in these plots. Arnold and Potter (1987) indicated that trap catches of predacious arthropods, specifically Araneae, Staphylinidae and Carabidae were significantly reduced by insecticides, particularly in late-summer soil treatment with Diazinon.

Mikhail *et al*. (1995) mentioned that the use of bacterial insecticides, such as *Bacillus thuringiensis* (BT), would be beneficial for non-target organisms because of its more specific toxicity. The field effect of BT on non-target populations has been reviewed, and conclusion is reached that an incomplete picture emerges.

6- Cropping Systems:

Cropping systems must incorporate in the relationships between farm practices and the ecosystem to create an equilibrium where farm inputs enhance rather than replace natural processes (Rizk *et al*. 2009).

A- Monoculture:

Monoculture is a method of growing only one crop at a time in a given field, is a very widespread practice, but there are questions about its sustainability, especially if the same crop is grown every year (Rizk, 2015). In monoculture, treatment effects are usually attributed to competition for moisture, light and nutrient supply. Monoculture has adverse effects on soil fauna populations (Marais *et al.* 2012).Spiders are the most diverse predators in any terrestrial ecosystem (Wise 1993). Spider assemblages are highly influenced by variations in plant community structure,ecosystem dynamic such as soil and ambient humidity and temperature (Bonte *et al.*2002).Rizk *et al*. (2009) found that increasing the number of spiders in clover monoculture system, could be a result of the highest numbers of herbivores and detritivores- groups, this deduction is supported with Bardwell and Averill (1997)and Malony *et al.* (2003) who showed that spiders preyed upon collembola and small dipterous larvae located in the ground. Tahir and Butt (2009) indicated that the spider densities vary with phenology of crops. In general, the density of the spiders in the fields increase with the increase in plant size and complexity, thus smaller plant host fewer spiders than tall ones (Liu *et al*., 2003).

B- Intercropping:

Intercropping, the agricultural practice of cultivating two or more crops in the same area at the same time is an old and commonly used cropping practice which aims to match efficiently with crop demands to the available growth resources and labor. Intercropping has many different benefits. It can prevent disease and pests, maintain soil fertility, and utilize the land to its full potential (Rizk and Mikhail 2000; Rizk 2001 ;Ghosh, 2004). The most common advantage of intercropping is to produce a greater yield on a given piece of land by achieving more efficient use of the available growth resources that would not otherwise be utilized by each single crop grown alone (Lithourgidis *et al*., 2011).

When two or more crops are cultivated together it is natural to expect that crop mixtures can provide a wide variety of plant types resulting in diverse easily decomposable residues with diverse root systems to support the soil biota (Thies and Abawi 2009).

Many authors studied the effect of intercropping system throughout certain crops combinations such as Metwally (1978); Shafshak *et al*. (1984); Rizk (2001);Rizk *et al*.(2002) ; Ghallab *et al*. (2005) and Rizk *et al*.(2012). It is a popular system of cultivation for maximizing yields of crops. Several authors have reported that the different cover crops enhance the activity-density of the soil fauna, Hammond (1990). Others indicated that infestation rates and pest populations are reduced in polyculture system than in monoculture of different field crops, Altieri *et al*. (1987); Sharef-El-Din *et al*. (1993); El-Khouly *et al*. (1994); Rizk *et al*. (2002), Rizk *et al*. (2009) and Rizk and El- Gayar (2014).

In intercrops, the partitioning of these resources reduces competitions as the requirements of different species are also different. Each crop has a particular group of associated species of weeds and pests as well as a special group of soil animals (Hossein *et al*. 2012).

Intercropping of non-legume plant with a legume crop is proving a successful system for better use of nutrients by plants, particularly in nitrogen deficient soils. Such a system may affect soil fauna activity (Rizk and El-Gayar 2014). Wheat alone had higher numbers of soil fauna than faba bean alone. This is perhaps related to moisture shade of plants, narrow spacing and nutrient supply. Ghabbour (1991) indicated that this difference may be due to shade of plants and available humidity expressed as water requirements for each crop in addition to density of plants/area. With increasing density of faba bean intercropped with wheat, the total number of soil fauna decreased, (Rizk and El- Gayar 2014). Faba bean roots increase the nitrogen content of the soil and generally has a diverse effect on the soil fauna (Sharshir, 1998; Rizk and Mikhail, 2000b).

Also, Rizk and El-Gayar (2014) found that relatively high abundance of the community of collembolan on the wheat plot more than in the faba bean plot. Collembola in all intercropped plantation are effected by moisture conditions of plants, spacing and vegetation type. Wallwork (1976) and Guillén *et al*. (2006) indicated that collembolan usually form an important part of the permanent fauna of soils of high moisture content.

Habashy *et al*. (2005) indicated that the diversity of the spider fauna in a given site is often related to the structural diversity of the habitat. Indirectly, the surface vegetation affects spider population density and biodiversity, which is influenced by microclimate of the plant. Where growth dependent on a mosaic of microclimatic conditions is produced with shaded areas interspersed with more open exposed area. These variations in sun and shade have a marked effect on the horizontal distribution patterns of many pests affected directly on the growth rate of spiders. Wallwork (1976) explained that spider populations are separated by different preferences for microclimatic conditions, although these preferences may vary within a species, during the reproductive period.

Rizk *et al*. (2009) found that spider increased in the intercropping system. Jogar *et al*. (2004) showed that the increase of ground cover density in plant communities could enhance the abundance of spider assemblages. Agnew and Smith (1999)and Ghallab *et al.* (2005) they determined the abundance of spiders in dense foliage which offer shade, protection and humidity, favorable to spiders. Also, increasing the number of spiders could be a result of the highest numbers of herbivores and detrivores-groups, this deduction is supported with Bardwell and Averill, (1997) and Malony *et al*. (2003) who showed that spiders preyed upon collembola and small dipterous larvae located in the ground; Geetha and Gopalan (1999) reported that spider (Lycosidae) are one of the most important predators of leaf hopper pests of rice and can result in a reduction in pest populations similar to that seen with insecticide use.

Rizk *et al*. (2002) noticed that chemical composition of plants is of great importance in guiding the insect in the selection process. In addition Habashy *et al.* (2005) indicated that spiders , might be affected with volatile garlic deterrents.

Rizk and El- Gayar (2014) found that soils under intercropping systems recorded lower mites abundance and diversity. This result is in accordance with those by Noti *et al*. (2003) and Cianciolo and Norton (2006) who concluded that the diversity and abundance of soil mites could be attributed to regular cultivation resulting in disturbance. Anderson (1978) showed a positive correlation between oribatid mite species diversity and the habitat diversity. Moreover, the kind of plant material and organic litter may influence the species and functional groups of soil animals, herbivores and saprophages (detritivores), which feed directly on this material (Rizk and El-Gayar 2014).

Felix *et al*. (2009) found that the abundance of herbivores on maize would be less in the biculture than in the monoculture, and foraging activity would be higher in biculture.

7- The Deferens Between Conventional Agricultures and Organic Agriculture on Soil Fauna :

In conventional agriculture, synthetic pesticides can have negative impacts on beneficial arthropods. Species found in most organic farms provide means of agricultural sustainability by reducing the amount of human inputs (e. g. fertilizers, pesticides).Organic agricultural methods are believed to be more environmentally sound than intensive agriculture, which is dependent on the routine use of herbicides, pesticides and inorganic nutrient applications in the production of crops.

Organic farming is reported to increase diversity in the agricultural landscape, including for example, carabid beetles (Dritschilo and Wanner 1980; Kromp 1989; Pfiffner and Niggli 1996; Abd El- Karim *et al*.2016). Organic agricultural methods generally increase biodiversity, also increase the abundance of many species and organism groups compared with conventional methods (Janne *et al*. 2005). Wallwork (1976) indicated that, the common practice of applying organic and inorganic material in the form of manure, compost or fertilizer to cultivated soils often results in increased densities of soil animals and promotes a greater degree of activity by soil bacteria and fungi.

Organic management promotes the development of soil fauna such as earthworms and above ground arthropods, improving the growth conditions of the crop (Rizk *et al*. 2015). More abundant predators help to control harmful organisms.

1-Spiders :

Spiders constitute one of the major groups of generalist predators due to their high abundance and predominantly insectivorous feeding habits (Tahir and Butt 2009). However, several factors affect population density and diversity of spiders. Of these, organic field support a higher abundance of spiders than conventional fields (Feber *et al*. 1998; Fuller *et al*. 2005; Schmidt *et al*. 2005; Rizk *et al*. 2015 and Abd El-karim *et al*. 2016).

The biological diversity in the organic system is important because it contributes in keeping the biological equilibrium, which is essential in an agroecosystem (Rizk *et al*. 2015). It brings about greater stability for the system and consequently fewer problems with diseases and pests (Bettiol *et al*. 2002). Such systems could potentially sustain longer or more diverse spider communities than more intensive farming systems because of the absence of agrochemical use and the typically more complex crop rotations within the system. For example; Gluck and Ingrish (1990) showed that intensively farmed fields had fewer spider species and lower activity of Lycosidae than bio-dynamic fields.

Rizk *et al*. (2015) found that spider was considerably more active in organic plots for most species with the least on the conventional plots. In general, spider abundance was highest in the organic management plants, while conventional cultivation plants had higher species diversity. These results go in line with Eyre *et al*. (2008) and in contrast to other reports.

Abd El-Karim *et al*. (2016) indicated that the vegetation type may influence spider abundance. The higher spider densities found in organic field (Schmidt *et al*. 2005) suggested it is favorable habitat for spiders. It is argued that organic systems are more diverse and therefore more stable, resulting in lower incidences of pest and disease problems and increased biodiversity (Lampkin 1990). Also, Tahir&Butt (2009) found that high abundance of spiders in the organic field might be due to rapid increase in the population of detritiovores and plankton feeders after the addition of organic manure. These organisms serve as alternate prey for ground spiders in the absence of potential prey items in the fields (Settle *et al*. 1996).

Booij and Noorlander(1992) and Feber *et al*.(1998) reported that a higher abundance of spiders in organic arable fields richer understory vegetation, providing greater structural complexity and more suitable microclimate (as well as, supplying prey species with a greater abundance of plant food) was cited as the principal factor.

Organic fields also provide more diverse and complex habitat for spiders (especially Lycosidae) than conventionally farmed fields (Wisniewska and Prokopy, 1997; Feber *et al*. 1998; Yardim and Edward, 1998; Schmidt *et al*. 2005; Eyre *et al*.2008; Abd El-Karim *et al*. 2016).

Hole *et al*. (2004) demonstrated that species abundance and/or richness, across a wide-range of taxa, tend to be higher on organic farms than on locally representative conventional farms. So , Abd El-Karim *et al*. (2016) conducted reason is that increasing soil microbial community in the organic fields provides a healthier one more than conventional soil system.

2- Beetles:

Insects such as beetles communities are the most commonly studied animal group in comparisons of farming systems. Generally higher abundance, and some evidence for greater species richness of carabids in organically managed fields

(Dritschilo and Wanner, 1980; Hokkanen and Holopainen, 1986; Kromp, 1989, 1990; Booij and Noorlander, 1992; Carcamo *et al*. 1995; Clark, 1999; and Irmler, 2003).

Also, Brooks *et al*. (1995) and Anderson and Eltun (2000) meanwhile, reported generally higher activity densities of carabids in organic fields, but lower activity densities of staphylinids. Kross and Schaefer (1998) also found a lower activity and lower species richness of staphylinid on organic fields. Anderson and Eltun (2000) suggested that competition with elevated numbers of carabids on organic fields may suppress staphylinid abundance. Hutton and Giller (2003) reported significantly greater beetle biomass, diversity and species richness on organic farms (on average 38%) more species than on conventional farms.

Evidence suggested that the distribution and abundance of carabids was linked to variation in vegetation structure (Kromp,1989 and 1990; Irmler 2003). Also, Kromp (1999) showed that the carabid species most favored by organic farming were open field species, indicating that organic farming may enhance the abundance and diversity of habitat specialists to a larger extent than generalists.

3- Other arthropods:

Many studies suggested that organically managed fields contain a greater abundance an diversity of arthropods than conventionally managed fields (Brooks *et al*.1995; Beery *et al*.1996; Redderson, 1997; Letourneau and Goldstein, 2001). However, there were clear differences in response between taxonomic groups.

Whilst, aphids and their natural enemies tended to be more abundant in conventional fields, where more abundant food resources are provide by heavily chemical fertilizers, faster growing crops (Moreby *et al*. 1994; Reddersen, 1997), groups such as Acari (mites), Formicidae (ants) and Heteroptera (true bugs) tended to show the reverse (Moreby, 1996; Reddersen, 1997; Yeates *et al*. 1997).

Collembola showed few differences between management regimes (Czarnecki and Paprocki, 1997; Yeates *et al*. 1997; Alvaraz *et al*. 2001), whilst other groups such as Diptera (flies) and Hymenoptera (sow-flies, wasps, bees) displayed in consistence's between studies (Moreby *et al*. 1994; Reddersen, 1997). Individuals species within groups also displayed in consistence's, with some more abundant under organic farming than conventional farming.

Earthworms are highly suitable bio-indicators of soil fertility, and they are known for their sensitivity to synthetic pesticides and to many agricultural practices. Janne *et al*. (2005) found that a significant positive effect on earthworms abundance of organic farming. Higher amounts of organic material in the soil increases earthworm abundance , and soil fauna in general in agricultural soils. On the other hand, in conventional agriculture, earthworms are effected by the use of harmful pesticides and intensive soil cultivation.

Also, micro-arthropods and fungi responded positively to organic management, while there were no clear effects on microbial activity or biomass.

Organic agriculture is dependent upon stabilizing agro-ecosystems, maintaining ecological balances and developing biological processes to their optimum, and linking agricultural activities with the conservation of biodiversity.

Thus higher levels of biodiversity can strengthen functions essential for farming systems, and therefore agricultural performance. Enhancing functional biodiversity is a key ecological strategy to bring sustainability to production on organic farms.

Organic agricultural method usually increased species richness compared with conventional method. There are positive effects of organic farming on species richness of all organism groups except non-predatory insects and soil organisms.

Also, a positive effect of organic farming on abundance was found. Organic soil management improves soil structure by increasing soil activity, thus reducing the risk of erosion.

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ARABIC SUMMARY

بحث مرجعى:أثر الممارسات الزراعية على الوفرة والتنوع البيولوجي لحيوانات التربة

مارجريت عدلى رزق[١] ، وفائي زكى عازر ميخائيل[٢] ، مني محمد أجمد غلاب[١] ،
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في هذه الورقة سوف نستعرض (البحوث الأخيرة حول) آثار الممارسات الزراعية على التنوع البيولوجي لحيوانات التربة المفصلية الأرجل مع إشارة بصفة خاصة إلى العناكب الحقيقية . كما تدرس هذه المقالة الآثار الضارة لهذه الممارسات المكثفة ، كذلك استعراض الممارسات الزراعية التي تهدف إلى الإقلال من الأثار الضارة لهذه الممارسات علي تناقص حيوانات التربة. وقد ارتبطت الممارسات الزراعية الحديثة، بما في ذلك الحرث والاستخدام المكثف للمبيدات الحشرية التقليدية، على نطاق واسع بانخفاض التنوع البيولوجي في النظم الإيكولوجية الزراعية. كما سيتم مناقشة اثر الزراعة العضوية ، وتعريض التربة للشمس ، والزراعة البينية ، والزراعات متعددة المحاصيل وذات المحصول الواحد ، والتعاقب المحصولي وإضافة الأسمدة.ويشير التنوع البيولوجي إلى تنوع الجينات والأنواع والنظم الإيكولوجية. كما نناقش أفضل طريقة لتطبيق الزراعة المستدامة التي تزيد كثافة وتعداد حيوانات التربة والحفاظ على التنوع البيولوجي.