The Abundance and Diversity of Meso-and Macrofauna in Vineyard Soils under Different Management Practices

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Declaration:

I the undersigned hereby declare that the work contained in this thesis is my own original work and has not previously in its entirety or in part been submitted at any university for a degree.

Abstract

The agricultural sector in South Africa relies heavily on the use of pesticides to protect crops against pest organisms. Pesticides can affect non-target organisms such as the meso- and macrofauna in the soil detrimentally. Since these organisms play an important role in the processes of mineralization and decomposition in the soil and contribute to soil fertility, it is important that they are protected. A large amount of published literature exists on the biological importance of soil meso- and macrofauna and the effects that various agricultural practices have on them.

The main aim of this study was to investigate the influence of agricultural practices on the abundance and diversity of meso- and macrofauna in different vineyard soils. A comparative study was conducted of an organically managed, conventionally managed and an uncultivated control soil. A secondary aim was to determine the effect of these agricultural management practices on the biological activity of these animals.

Soil samples were taken, from which mesofauna (Collembola and Acari) were extracted with a modified Tullgren extractor, identified and counted. Earthworms were extracted from the soil using hand sorting methods. Soil parameters such as pH, water holding capacity, organic matter content, soil texture and soil respiration were determined. Bait lamina and litter-bags were also used to help determine the biological activity within the soil.

The mesofauna diversity was quantified using the Shannon Weiner diversity index, as well as a diversity index described by Cancela da Fonseca and Sarkar (1996). Differences in abundance of both the meso-and macrofauna were statistically measured using ANOVA's. Biological activity results were also interpreted using ANOVA's.

Results indicate that the abundance of the mesofauna was the highest at the organically treated vineyard soil and lowest in the conventionally managed soil where pesticide application took place. The earthworms also showed the same trend as the mesofauna, but were much more influenced by seasonal changes. Biological activity, according to the bait lamina and the litter-bag results, was higher in both the conventionally and organically managed soils than in the control, but no statistical significant differences were found between the two experimental soils. The soil respiration (CO_2-flux), also indicating biological activity, was highest in the organically treated soil and lowest in the conventionally treated soil.

The different sampling techniques used gave variable results and although the organically managed soil proved to have higher abundances of both meso- and macrofauna, the biological activity did not show the same trends. In conclusion the data did not give enough evidence as to whether organic management practices were more beneficial than conventional management practices for the maintenance of soil biodiversity.

Opsomming

Die Suid Afrikaanse Landbousektor steun hewig op die gebruik van verskillende chemiese pestisiede om oeste teen pes organismes te beskerm. Pestisiede kon ook verskeie ander nie-teikenorganismes soos die meso- en makrofauna in die grond negatief affekteer. Hierdie organismes behoort beskerm te word omdat hulle ’n belangrike rol speel in grondprosesse soos mineralisering, en die afbreek van organiese materiaal. Hierdie organismes dra ook by tot die vrugbaarheid van die grond. Daar is heelwat gepubliseerde literatuur beskikbaar wat verband hou met die biologiese belangrikheid van grond meso- en makrofauna en die effekte wat verskeie landbou behandelings op hulle het.

Die primêre doel van hierdie studie was om vas te stel watter invloed konvensionele landboupraktyke op die hoeveelheid en diversiteit van meso- en makrofauna in verskillende wingerdgronde het. ’n Vergelykende studie is gedoen om wingerdgronde wat konvensioneel en organies behandel is sowel as ’n onbehandelde kontrolegrond met natuurlike plantegroei met mekaar te vergelyk. ’n Sekondêre doel van hierdie studie was ook om die effek van die verskillende boerderymetodes op die biologiese akitiwiteit in die grond te ondersoek.

Grondmonsters is geneem, waaruit die mesofauna (Collembola en Acari) deur middel van ’n aangepaste Tullgren ekstraktor ge-ekstraheer, geïdentifiseer en getel. Die erdwurms is deur middel van handsorteringsmetodes versamel. Die volgende grond parameters is gemeet: pH, waterhouvermoë, organiese materiaal inhoud, grondtekstuur en grondrespirasie. “Bait lamina“ en “litter bags“ is ook gebruik om biologiese aktiwiteit in die grond te bepaal.

Die diversiteit van mesofauna is bepaal met die Shannon Weiner diversiteitsindeks, as ook ’n diversiteitsindeks wat deur Cancela da Fonseca en Sarkar (1996) ontwikkel is. Die resultate van beide die meso- en makrofauna hoeveelhede in die verskillende wingerdgronde is met mekaar vergelyk deur van ANOVA’s gebruik te maak. Die

resultate van die biologiese aktiwiteit is ook deur middel van ANOVO's statisties met mekaar vergelyk.

Die resultate het aangetoon dat die hoeveelheid mesofauna die hoogste in die organies behandelde grond en die laagste in konvensionele grond was. Die erdwurms het dieselfde patroon as die mesofauna getoon, maar is baie meer deur seisoenale faktore geaffekteer, bv. reënval. Volgens die resultate van die "bait lamina" en die "litter bags" was die biologiese aktiwiteit in die grond hoër in beide die eksperimentele grond as in die kontrolegrond. Die grondrespirasie (CO_2-puls) was hoër in die kontrolegrond as in die ander eksperimentele gronde.

Daar was groot variasie tussen die resultate wat met die verskillende tegnieke verkry is en alhoewel die organiese perseel hoër hoeveelhede van beide meso- en makrofauna gehad het, het die biologiese aktiwiteit nie dieselfde tendens gewys nie. Vanuit die data wat verkry is kon daar dus nie met sekerheid afgelei word dat organiese boerderymetodes beter vir die biodiversiteit van gronde,soos hier gemeet, is as konvensionele boerderymetodes nie.

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1. Introduction

The population of the world is more than six billion people at present and according to some estimates it is expected it to increase to ten billion by the year 2050 (Xiong, *et al.* 2001). It will increase the pressure on agricultural lands to provide food for the masses. The use of inorganic fertilisers alone will not ensure adequate sustainable agricultural production levels, and the recycling of sewage and other wastes will be essential for economic and ecological survival (Cameron, *et al.* 1997).

The farmers also increasingly turned to chemical methods to eliminate and prevent pests and diseases to produce greater yields. These chemicals (pesticides and chemical fertilisers), when used correctly, do aid the farmer to increase the yield, but it may also have negative effects on the non-target organisms represented by both the meso- and macrofauna, as well as to the consumers (Albertus 2002, Sanghi & Tewari 2001). This raises the question whether it would be better for soil fertility as well as the consumers to use organic rather than conventional agricultural methods. Also, what the effects of these management practices are on the meso- and macrofauna within agricultural soils.

Organic farming practices are becoming increasingly popular as a result of the ever increasing consumer demand for organically produced products, due to the public concern of the contamination of food and environment (Petersen 2000). Organic farming can be defined as an ecological production management system. Supporters of the organic farming practice maintain that it promotes and enhances biodiversity, biological cycles and soil biological activity, based on minimal use of off-farm inputs and on management practices that restore, maintain and enhance ecological harmony. The principal guidelines for organic production are to use materials and practices that enhance the ecological balance of natural systems and which integrate the parts of the farming system into an ecological whole. Organic agriculture practices cannot ensure that products are completely free of residues, however, methods are used to minimize pollution from air, soil and water. Organic food handlers, processors and retailers adhere to standards that maintain the integrity of organic agriculture products. The primary goal of organic agriculture is to optimise the health and productivity of interdependent communities of soil life, plants, animals and people (National Organic Standards Board 1995).

Whalen *et al.* (1998) found that the number of earthworms were significantly higher in organically managed plots than in the conventionally farmed plots. This study has shown that the long term conventional cultivation of these plots was detrimental to the survival of the earthworm communities in them. Planck (1998), however, has shown that the conversion from conventional to organic can take up to five years or more before the farmer gets sustainable crops.

Organically farmed plots were found to produce lower runoff concentrations of NH_4^+ and NO_3^- than the conventionally managed plots, using inorganic fertilisers. This could however be attributed to the presence of greater numbers of earthworms, which in turn can be traced back to the organic management practices (Shuster *et al.* 2002).

In contrast to organic farming methods, conventional farming relies heavily on methods aimed at controlling or altering the natural state of the soil environment through the use of various pesticides and inorganic fertilisers (Petersen 2000).

Man made agro-systems and anthropological influences on soils are increasing. Several events, such as soil tillage, fertilization and the application of pesticides during the cropping season to increase the yield of crops, interfere with soil-bourn food-webs by breaking the functional chains and decreasing the diversity of the soil fauna (Naeem *et al.* 1994, Larink 1997). Thus only short periods remain for organisms and populations to recover between cropping seasons. This has a negative effect on the productivity of the soil, because the fertility of the soil does not only depend on physical properties, or on the amount of minerals in the soil, but it can also be related to the amount of biological activity within the soil (Benckiser 1997, Larink 1997).

Studies in Britain have shown that in the presence of farming there were large declines in various taxa present in farmlands. Almost half of the plants, a third of insects and four-fifths of the bird species in British farmlands are experiencing decline (Robinson and Sutherland 2002). Work done by Edwards and Lofty (1982) supported findings that soil fauna tend to decrease due to agricultural practices, as well as a change in the community structure of earthworms present in the agricultural soils. This must be of great concern to

South African farmers, with the heart of the country's wine and fruit industry being situated in the middle of an ecological hotspot.

Organic production was shown to provide healthy food in developing countries (Plank 1998). Organic production is most consistent in creating natural feedback mechanisms. Within organic agricultural management practices the view towards soil has changed. Soil is not just seen as a substrate from which plant roots obtain their nutrients, but it is considered as a living, self-organising ecosystem which depends on the soil-fauna to play an important role in maintaining the integrity of the system (Goewie 2002). This ecosystem is also generally believed to contain organisms that contribute beneficially to soil fertility.

Within conventional management practices the natural cycles, e.g. Carbon cycle and nitrogen cycle are influenced negatively due to the artificial, off farm, inputs in order to increase production. Shuster et al. (2002) have shown that practices that decrease earthworm numbers and species diversity, such as the use of pesticides and certain fertilisers, could increase the runoff and lead to higher soil losses unless these substances are earthworm friendly.

Both earthworms and springtails form an important component of the animal biomass in many soils (Sims and Gerard 1985, Edwards 1991, Makeschin 1997, André *et al.* 2002). These animals play an important role in the soil ecosystem by participating in the cycling of organic matter and the modification of soil structures. Earthworms and Collembola can be seen as being ecosystem engineers, and have various positive effects on plants within certain soils (Hopkin 1997, Sims and Gerard 1985, Brown 1995, Lussenhop 1996).

Earthworms are known from an early time to promote soil fertility (Makeschin 1997). With the intensification of agriculture in post-war times, it was suggested that agricultural ecosystems could be sustainable without taking particular care of the soil fauna. This, however, seems to be false and the deterioration of soil structure within intensely used agricultural soils serves as evidence to the effects of neglecting the inputs and ecological function of the soil fauna (Makeschin 1997).

As eudaphic organisms earthworms spend their entire life cycle within the soil. By burrowing, casting, feeding and propagating, earthworms directly and indirectly influence the physical and chemical properties of the soil in many ways and establish the basis for other organisms in the soil ecosystem (Makeschin 1997). In many temperate and tropical soils earthworms are the most important of the soil fauna involved in the regulation of decomposition and nutrient cycling processes and the modification of physical soil properties (Brown 1995).

Boyle *et al.* (1997) have shown that in the absence of earthworms the overall physical appearance of soils at the end of the plant growth period was a very loosely bound mixture, only held together by the plant roots. Little structural development has taken place in comparison with earthworm worked soils. These soils have a poor moisture retention capacity and relatively low suction pressures, causing these soils to be more drought prone than the other earthworm worked soils. The earthworm worked soils in contrast tended to be less fibrous, more compact, more dense, have lower infiltration capacity and better water retention properties. These soils had visual evidence of significant structural modification in comparison with unworked soils. This was strongly related to the fertiliser regime that was used (Boyle *et al.* 1997).

Earthworm burrows aerate the soil and provide pathways for water to flow in, these conduct water away from ponded soil surfaces. Deep burrowing species form hotspots of organic material and nutrient cycling and are associated with high rates of residue consumption in tilled cropping systems (Shuster *et al.* 2002).

Earthworms can be classified into three main ecological categories, based on their behaviour and the soil depth at which they spent most of their lives and activities (Bouche 1977):

1. the Epiges,
2. the Endoges and,
3. the Aneciques.

The epiges are litter-dwelling species that live close to the soil surface and have a typical r-population growth curve with a low competition potential. This group of earthworms are more important in the early decomposition stages and during litter comminution, e.g.

Eisenia fetida. Endoges are typical soil inhabitants and their living space is within the first 30-40cm of the top soil. These worms have a broad ecological range, and are often the main group of earthworms found within arable soils. They ingest large quantities of soil and are responsible for pronounced changes in the physical soil structure. This group include species such as *Aporrectodea caliginosa*. The Aneciques live at a depth down to 2-3m, but feed mainly on litter close to the surface. This group of earthworms forms vertical burrows that are important for soil gaseous and water regimes, as well as for the burying of surface litter. Earthworm activity can thus significantly affect the properties and processes of the soil habitat, including suitability for other organisms, resulting from changes to the physical and chemical properties of the soil (Brown 1995, Boyle 1997, Makeschin 1997).

Earthworm populations in South Africa have been changed and influenced due to anthropological activities (Reinecke 1983). The species composition of the earthworms have also been changed and there are more than twenty different exotic species of megadrile fauna belonging to at least four families present in South African soils (Ljungstrom 1972). Most of these species came from America and Europe, and was brought here with European settlers after 1500 (Reinecke 1983). It has been shown that in agricultural soils these exotic species have dominance in population density, biomass and distributional range over the endemic species (Visser & Reinecke 1977).

Collembola, mites and earthworms play an important role in transforming the above ground litter layer entering the soil. They affect the rate of decomposition and humification through microbial action by grazing on the bacteria and fungi present in the organic substrates (Brussaard 1998). It was shown that the soil micro- and mesofauna do not contribute a great deal to the total soil respiration, but accelerate organic matter turnover under nutrient-limited circumstances (Petersen 1994, Brussaard 1998).

With the exception of a few species, Collembola are considered to be useful organisms and their role in decomposition is beneficial to the long-term well being of soils. Several studies have examined the effects of chemicals on laboratory and field populations of Collembola (Hopkin 1997). The studies on natural populations, however, have been mainly focussed on grasslands, forests and cereal crops.

1.1 Aim and Rationale:

The study of soil fauna diversity is illustrative of problems that can be found in other ecosystems around the globe (André *et al.* 2002). The aim of this study is to evaluate the effect of different management practises (conventional farming vs. organic farming) used in vineyards on the diversity and abundance of meso- and macrofauna in vineyard soils. There are substantial literature about the effects of pesticides and fertilisers on these different faunal groups done in Europe and America (e.g. Robertson and Sutherland 2002). This shows that farming practices have an effect on soil biodiversity and thus may affect soil fertility in a negative way in the long run. This study will try to prove or disprove this statement, and at the same time try to investigate whether organic farming can be the answer to this problem.

According to Andre *et al.* (2002) there is a great need for further studies in soil biodiversity. The debate on soil biodiversity will remain open as long as the sampling methodologies are not set up, critically evaluated and largely used. Most of the studies largely overlook the micro-arthropod populations, and some groups are neglected. Only about 10% of the soil micro-arthropod populations have been explored and the same amount of the species has proper taxonomy (Andre *et al.* 2002).

2 Materials and methods

2.1 Study site and soil parameters

The study site is situated on the farm Plaisir de Merle. This farm, of which 375 ha out of a possible 402ha are used for viticulture, is situated in Simondium (33°, 51' South; 18°, 56' East) in the Paarl valley, Western Cape, South Africa. This farm was chosen for this study, because both conventional and organic management is practiced in the vineyards. The Agricultural Research Council (ARC) also conducts research on the effects of various treatments on the plants and soil of this farm.

Plots for investigation were chosen in both the conventional and organically treated vineyards. The soil of both the conventional and organic plots was treated in the same way. A commercial product called Neutrog®, containing chicken faeces, was used as compost. The soil between the vines was mechanically tilled and covered with straw. A cover crop was sown in the working rows and Seagrow®, a commercial product containing fishmeal, was used as a soil conditioner. This procedure was followed as soil treatment for both the organically and conventionally managed vineyards throughout the period that the study was conducted. The only difference between the organic and conventional plots was the pesticides used, e.g. Copper-hydroxide and Mancozeb (see Table 2.1 for list). A control plot close to the vineyard, with the same soil properties, pH, water holding capacity and soil texture as the experimental plots, was selected for this study. This plot was previously unfarmed and contained natural vegetation, such as fynbos.

Soil parameters such as pH, water holding capacity, organic matter content and soil texture were measured. The pH was measured using Crison micro pH2001 pH and conductivity measurer. Water holding capacity was determined using a polystyrene plate with six divisions cut out of the plate. Gauze was attached to the bottom of the plate. Filter paper with a soil sample on top of it was placed on the gauze. The whole plate was placed in a tray filled with water so that the soil could absorb water. After three hours the plates with the water-saturated soil were placed on a tray of wet sand and left to drain for two hours. After this time the soil samples were weighed and dried for 48 hours at 60°C. They were weighed again to determine the moisture content, which equals the water holding capacity of the soil.

Table 2.1: Pesticides used in the various sampling blocks.

Conventional	Organic
Copper-hydroxide Mancozeb Penconazole Sulphur Trifloxystrobin	Copper-hydroxide Sulphur

The organic content of the soil was measured as the loss on ignition by heating a soil sample in a Gallenkamp oven at 500°C for three hours. The difference in the weight before and after the heating of the sample was accepted as the amount of organic content.

The soil texture for the respective plots was determined by the Soil Science Department at the University of Stellenbosch using sieves of various mesh sizes to determine the fraction of sand, silt and clay in the soil.

2.2 Sampling and extraction of Collembola and Acari

Field studies on soil invertebrates depend on a method to separate the animals from the soil. The methods used depend on the type of invertebrates sampled. Physical methods, as mentioned below, are more efficient in recovering all life stages of soil invertebrates, including sessile forms. However, such methods also recover recently died individuals and tend to produce damaged specimens that are difficult to identify. These methods are laborious and time consuming, limiting the number of samples that can be handled (Edwards 1991). Apart from hand sorting the two methods most commonly used to extract the soil mesofauna from the soil are:

1. Direct, namely mechanical or passive, by which the animals are physically separated from the soil by either washing or flotation and,
2. Indirect or active, which depend on the migration of the organisms towards a trapping device in response to an induced physiochemical gradient in their medium, e.g. Berlese-Tullgren funnels (Andrè *et al.* 2002).

The Tullgren extractor, which was built for and used in this study, is one of the most widely used sampling techniques for studying soil arthropods (Van Straallen & Rijninks 1982, Andrè *et al.* 2002). A modified extractor of this kind was constructed for this study by the Mechanical Services Department of the University of Stellenbosch.

Seven samples were taken once a month at each of the three experimental plots from May 2002 to July 2003, during which time the soil temperature and air temperature were measured for each sampling date. This was performed by means of a sharpened, open-ended stainless steel cylinder (Ø 5 cm, 7cm high) as shown in figure 2.1.

Figure 2.1: Metal cylinder used to take Collembola samples, here only partially inserted into the soil.

The cylinder was inserted into the soil with the help of a wooden hammer. When the cylinder was filled with soil a small hand spade was used to lift it out of the soil, preventing the soil from falling out when the cylinder was lifted. The cylinder was then closed on both sides using specially made lids. The moisture content of the soil remains constant by using this method, making the extraction of the organisms easier (Macfadyen 1961).

After the lids were removed from the metal samplers they were covered with mesh (0.5mm mesh size) and placed upright in a Tullgren-like extractor for seven days. The extraction of the springtails occurs due to the development of a temperature-moisture gradient in the extractor. The samples were heated from the top of the extractor to a temperature of about 35-40°C using an electrical element. The bottom was cooled using water and ice. This bottom part of the apparatus had an average temperature of between 5 and 15°C. According to Trägårdh (1933, from Aucamp *et al.* 1964) the organisms move down in the soil sample due to the desiccation of the upper layers of the sample from the top downwards. By moving down in the samples the animals fall through the mesh into glass containers filled with a preservative (96% ethanol). Van Straalen and Rijninks (1982) suggested that 65% of the organisms are normally extracted during the first 24 hours and 95% of the animals after 6 days. The cylinders were therefore kept in the extractor for seven days during the present study.

After being extracted the organisms were classified into five groups. The animals were sorted into three families of Collembola: Poduromorpha, Entomobryomorpha and Symphypleona; according to the body type, one group for mites and one group for other types of organisms, e.g. centipedes, ants and enchytraeidae. The mesofauna were identified using a combination of Eisenbeis and Wichard (1987), Picker *et al.* (2002) and personal class notes provided by Prof. C.A.M. van Gestel. The animals were counted in a Petri-dish under a dissection-microscope, using a Pasteur pipette to pick up the individual animals.

Temperature and rainfall data for the period of the study were also obtained from the Agricultural Research Council (ARC) at Nietvoorbij.

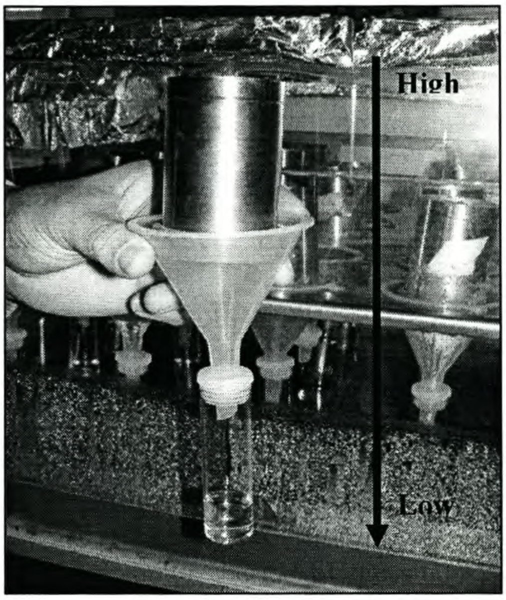

Figure 2.2: Tullgren-like extractor, the arrow indicating the direction of the temperature gradient by which the Collembola were extracted.

2.3 Sampling of Earthworms

There are various methods of sampling earthworms, ranging from chemical to mechanical methods (Edwards & Lofty 1982, Judd & Mason 1995, Tiwari & Mishra 1995, Schmidt & Curry 2001). For this study earthworms were sampled by digging a (25cm x 25cm x 30cm deep) cube of soil and searching for the worms by hand as described by Judd & Mason (1995). The worms were put in containers with soil from the particular sampling site and transported to the laboratory, where they were handled no later than 48 hours after being sampled. The individual worms were weighed using an electronic balance measuring to the nearest 100 µgrams. The sums of these measurements were used as an indication of the earthworm biomass per volume of the soil sample. The earthworms were identified, according to Sims and Gerard (1985), and divided into three classes;

1. Juveniles – worms without clitellums,
2. Adults – worms with clitellums,
3. Anterior section – the number of the damaged worms found within each sample due to the sampling method.

The earthworms were sampled twice seasonally on all three plots from June 2002 to July 2003. The sampling occurred on two consecutive months per season and a resting period of one month between seasons. Five sub-samples (cubes) were taken for each of the two experimental plots and control at each sample date. These five sub-samples were pooled together for each plot and season.

2.4 Measurements of soil biological activity

The bait-lamina test, first described by Von Törne (1990) and later by Kratz (1998), can be used as a tool to compare feeding activity of soil fauna on plots that vary in one or more factors (Larink 1994). It is also known to be a quick and simple method for determining small-scale distribution of biological activity (Helling *et al.* 1997, Paulus *et al.* 1999). The test consists of several sets of small plastic strips with a number of small perforations filled with a bait substance being exposed for a number of days in the field.

The plastic strips used in this study were 140mm long, 5mm broad and 1.5mm thick (Fig. 2.3). The laminae were perforated with 16 holes spaced 5mm between holes and a diameter of 2mm, tapered to 4 mm on the outside of the holes. The holes were filled with a bait substance to attract soil organisms. In a recent study laminae containing a nettle powder mixture as bait were shown to have significantly higher feeding activity than other bait substances (Reinecke *et al.* 2002). The bait used in the present study consisted of cellulose powder, nettle leaf powder and agar-agar, mixed together in a ratio of 6.5: 2.5: 1. The powdery mixture was mixed with distilled water to form a paste, which was smeared into the holes, using a knife. The filled bait-laminae were oven dried at 40°C for 24 hours (Helling *et al.* 1997), and the excess bait was removed from the laminae by hand to confine the bait to the holes. A set of 16 individual bait-laminae formed a single experimental test unit.

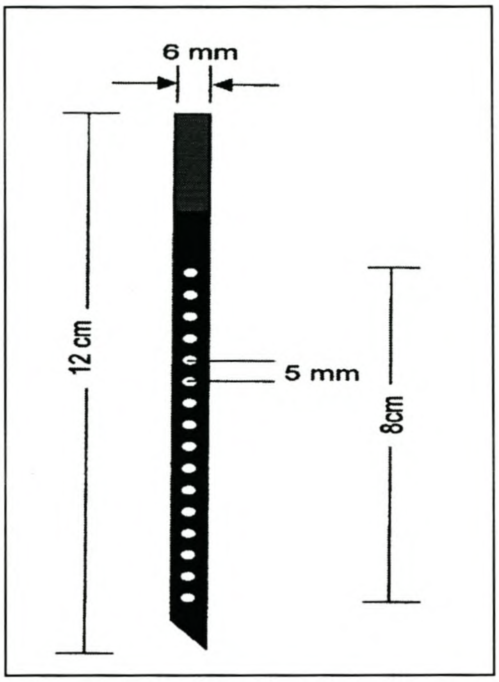

Figure 2.3: Dimensions of a Bait Lamina strip.

One set (test unit) of laminae were carefully inserted into vertical slits in the soil at each of the three plots using a knife to make a provisional slit. This was done to prevent the lamina from breaking and/or the bait from falling out (Larink 1994, Albertus 2002). Each lamina was inserted into the soil until the upper hole of the lamina was just covered by the soil. The laminae were carefully removed after twelve to nineteen days. The variation in time was due to availability of transport.

The removed bait-laminae were carefully washed in the laboratory, by wiping the individual laminae with a damp cloth to remove excess soil, after which they were placed on a light table and the empty holes or perforations were counted. For a better comparison the feeding activity was expressed in a standardised period of percentage bait eaten in ten days. The standardised period was obtained by dividing the number of holes made in the laminae by the soil organisms by the number of days the bait-laminae were in the soil, multiplied by ten (Albertus 2002).

For each plot a control unit of 16 bait laminae was prepared in exactly the same way as for the experimental units. One test unit was used in a pilot test. It was placed in and removed immediately after insertion and the holes counted. This accounts for the number of holes resulting from handling the laminae, thus providing a figure for the application of a correction factor. This was done three times throughout the sampling period for all the plots.

The litter bag method was originally described by Bocock and Gilbert (1957). The principle of the method is to enclose defined amounts of dried organic material, e.g. straw or leaf litter, into bags which are then buried in the soil to measure the decomposition rate of the contents within the bags. The litter bags 1measured approximately 10cm by 15cm and were made from nylon mesh curtains with 1mm mesh size (Reardon & Forbes 2001). The bags were non-degradable and flexible (Knacker *et al.* 2003). This mesh size was selected to exclude influence from the larger soil organisms, such as earthworms, and focus on the effect of the mesofauna (Seastedt 1984). Each of the individual litter bags was filled with approximately 10g of straw (Mateo & Romero 1996). The straw was oven dried for 48 hours at 60°C before it was weighed and inserted into the individual bags. Each bag was weighed and numbered with a permanent marker before it was inserted into the soil. Ten bags were buried at a depth of 5cm from the surface at each of the two experimental and control plots (Knacker *et al.* 2003). The litter bags were inserted into the soil during October 2003 and retrieved during January 2004.

After the litter bags were retrieved from the soil, the bags were individually washed, by rinsing it with water, to make sure that they were free from soil. The bags were dried for 24 hours at 80°C to get rid of the excess water. The dried litter bags were weighed individually and the differences were noted and expressed as percentage weight loss.

The CO_2-flux in the soil of the various plots was also measured as another measurement of biological activity. It was measured on soil samples taken at a depth of 2cm. The soil from the different sites was incubated for 24 hours at 20°C and 35°C respectively for each plot to simulate winter and summer conditions. The CO_2-flux was measured using a Licor LI-6400 Portable Photosynthesis System and 6400-09 Soil CO_2-flux chamber. Ten millilitres of distilled water were added to 50g of air dried soil. After the preparation of the soil it was incubated for an additional hour in a growth chamber at each of the various temperatures mentioned above. The CO_2-flux was measured immediately after removal from the growth chamber (Mills & Fey 2004). The Soil Science department of the University of Stellenbosch measured the CO_2-flux.

2.5 Statistical Methods

All data were analysed using MicroSoft Excel XP 2000, Jandel Scientific SigmaStat® 2.0 and Statisica software.

For each of the two experimental (organic and conventional) and control plots the significant differences in abundance between the systems and each group of organisms represented was determined using the Mann-Whitney test. Then the conventional and organic plots were compared to the control plot and to each other respectively using the ΔV index of biodiversity (Cancela da Fonseca and Sarkar 1996) for the five different taxa: three groups of Collembola, mites and other organisms (all animals found in the samples excluding the previous three groups). The main features of the index are as follows:

$$\Delta V = [V(x) + V(S) + V(n) + V(H'x) + V(H'y)]/5$$

Where x is the abundance of the taxonomic group; S is the number of taxonomic groups; n is the number of samples containing the taxon; $H'x$ is the taxonomic diversity index according to the Shannon-Weiner diversity index (Zar 1999); and $H'y$ is the spatial diversity index; and:

$$Vm = (Cm - Om)/(Cm + Om)$$

Where Cm is the parameter m value in the conventional plot; and Om is the parameter m value in the organic plot. If $Cm=Om$, there are no observed difference between the two plots. If $Cm<Om$ the difference in biodiversity is negative, thus the biodiversity is lower in the conventional plot than in the organic plot, and if $Cm>Om$ the difference is positive, the organic plot has a higher biodiversity. Thus the index ranges between -1 and +1 (Cortet *et al.* 2002, Burrows & Edwards 2002). A complete description of the method can be found in the work of Cancela da Fonseca and Sarkar (1996). This index seems to be a useful tool to measure the intensity of human impacts on biological communities and systems (Cancela da Folseca & Sarkar 1996).

The statistical differences in the feeding activities for the bait-lamina trials between the experimental and control plots were measured using the Mann Whitney *U*-test (Helling *et al.* 1998).

The Statistical Consultation unit of the University of Stellenbosch was consulted and they did further tests on the data provided during this study. They tested the differences between the abundances of the various faunal groups for the different treatments using ANOVA's. They also helped with the interpretation of the various statistical data used in this study.

3 Results

3.1 Physical soil properties

The physical properties (Table 3.1) of the three experimental plots were very similar. One of the only differences between the different experimental sites was the pH, varying between 7.9 for the organic and 6 for the control sites. The conventional site had an intermediate pH of 7.1 falling between the values for the organic and control sites. The conventional site had both the lowest water holding capacity and organic matter of the three experimental plots. The organic matter in the conventional plot was less than half of the amount of organic matter found in both the soils of the organic and the control sites. The amounts of sand, silt and clay in the soils were very similar for all three of the experimental plots, with the control being less sandy than the organic and the conventional sites, but with larger soil particles.

Table 3.1. Physical soil properties for the three experimental plots at Plaisir de Merle.

				Soil Fractions < 2mm			
	pH	**WHC**	**Org. matter**	**Sand**	**Silt**	**Clay**	**Soil Particles >2mm**
		[%]	[%]	[%]	[%]	[%]	[%]
CONV	**7.1**	**30**	**3.8**	**71**	**12**	**13**	**50**
ORG	**7.9**	**40**	**8**	**62**	**18**	**12**	**58**
CONTR	**6**	**45**	**10.6**	**56**	**20**	**13**	**57**

3.2 Collembola

The numbers of the Poduromorpha were significantly higher in the organically farmed plot during spring (2002) and decreased in the summer (2002/3) and autumn (2003).

There was no significant difference ($p<0.05$) between the abundance in any of the samples taken at the conventional vineyard and the control sites throughout the entire sampling period. There was also no significant difference between the values for the different seasons in the different treatments (Fig. 3.1), however, there were slightly higher numbers during the winter and autumn and slightly lower numbers for all the experimental sites except the organic plot. When all the individuals of the Poduromorpha samples were pooled together, there was a slight increase from winter to spring. The abundances decrease again from the spring towards summer, but there were no significant differences ($p<0.05$) between the different seasons (Fig. 3.2). With all the samples pooled together for the seasonal abundances of the different treatments, the abundance Poduromorpha was significantly higher ($p=0.000985$) in the organically treated site than both the conventional and the control sites (Fig. 3.3).

Both the Poduromorpha and the Entomobryomorpha were pooled together (Fig. 3.4.) to provide a clearer picture of the effect of the different management practices on Collembola as a faunal group, and to provide a better base for comparing Collembola with the Mites, as both faunal groups have a large number of families. The abundance of Collembola increased from the winter to reach a maximum level during the spring. The numbers decreased again towards the summer and autumn. The organic plot had a significantly higher abundance during spring than during the autumn ($p=0.046584 \pm 13.70315$), but it was not significantly higher than the winter and summer abundances found (fig. 3.4). For both the conventional and control sites there were no significant differences in the abundances found between the different seasons. The conventional and control sites showed a trend where the abundances were slightly higher during the winter and decreased towards the summer.

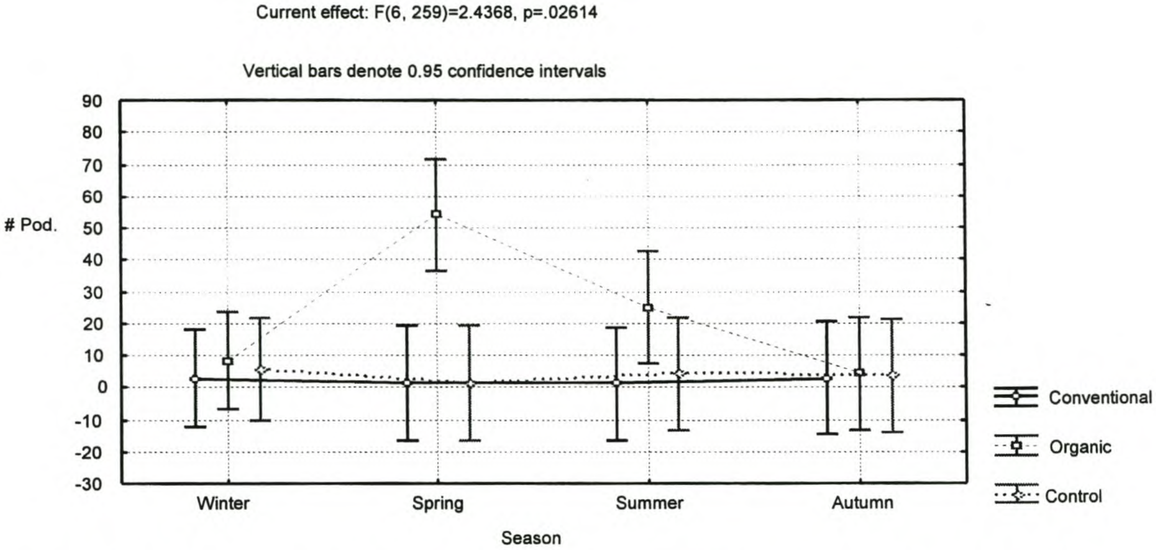

Figure 3.1: Seasonal abundances of Poduromorpha for the conventional, organic and control sites, winter and autumn samples for 2002 and 2003 were pooled together.

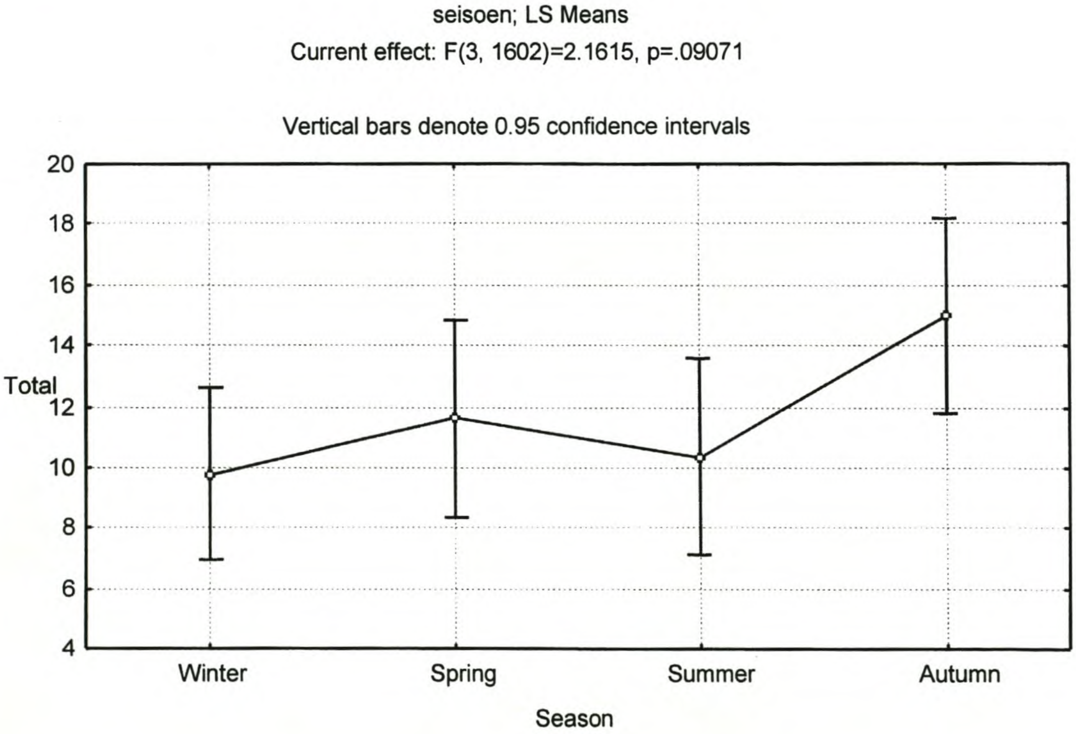

Figure 3.2: Total seasonal abundance of Poduromorpha, all the experimental and control sites were pooled together.

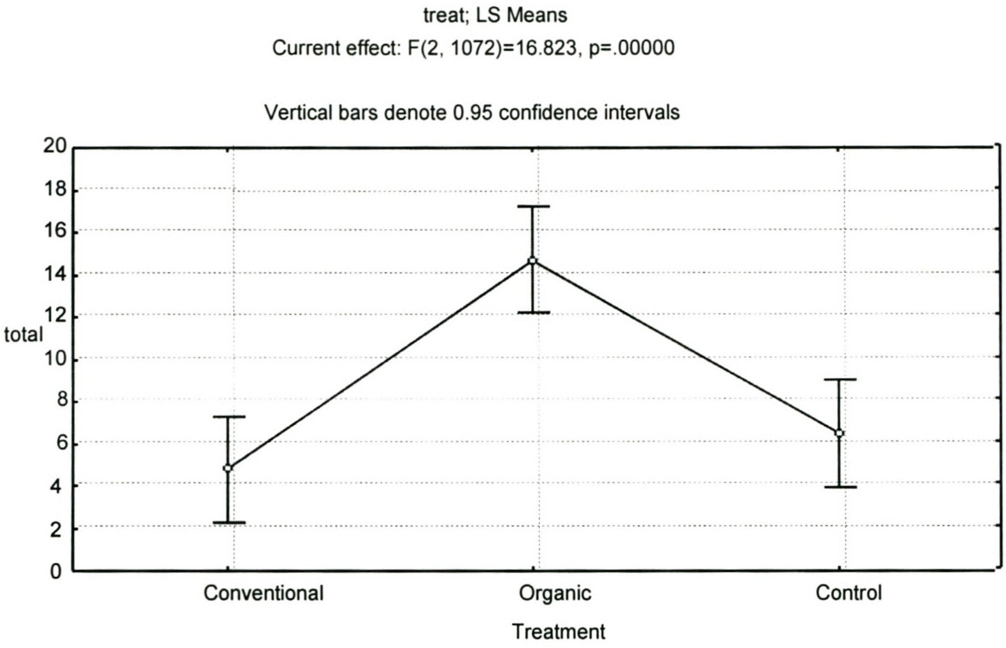

Figure 3.3: Total abundance of Poduromorpha in the conventional, organic and control sites.

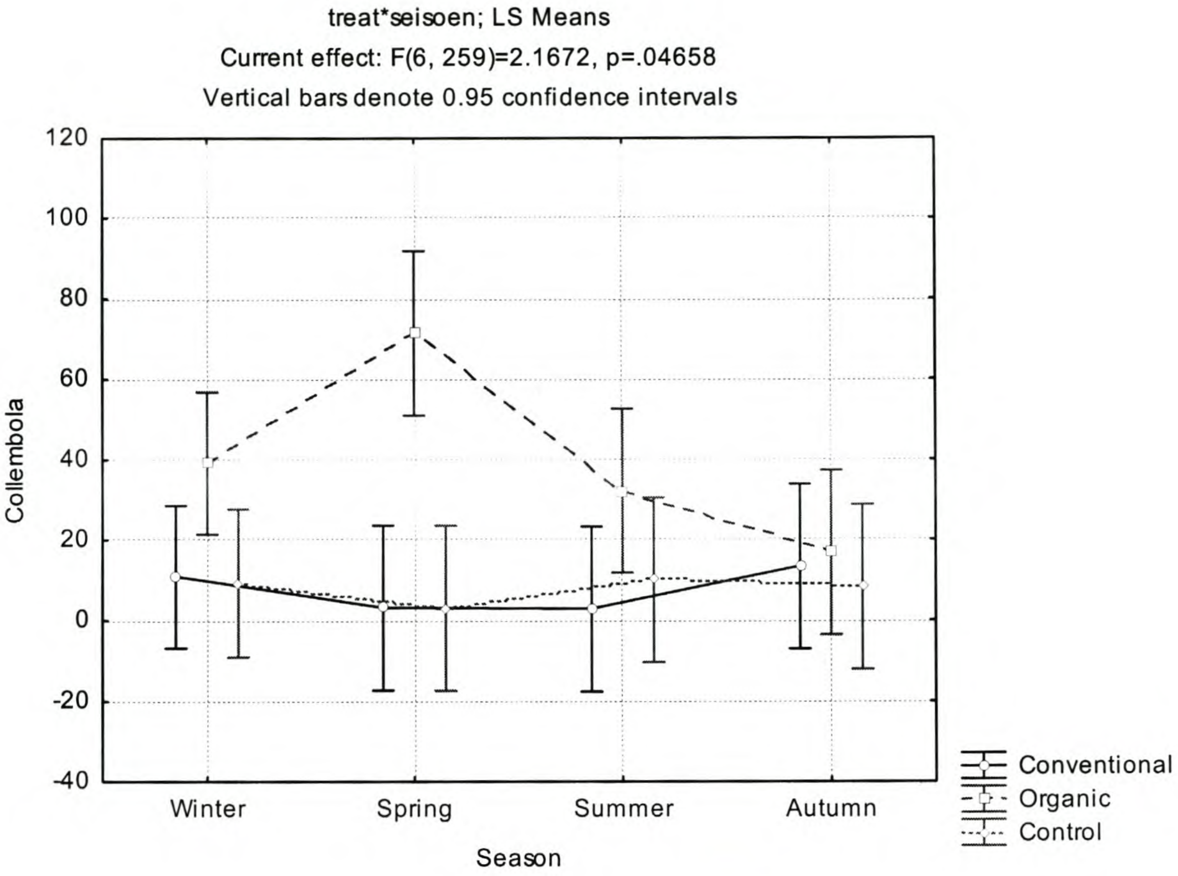

Figure 3.4: Seasonal abundances of all three groups of Collembola pooled together for the organic, conventional and control sites.

The number of mites found showed an overall trend of low numbers during the winter and an increase during summer and autumn. The conventional and control sites showed a decrease during spring and increase during the rest of the sampling period (Fig. 3.5). The organic plot showed a steady increase throughout the whole sampling period. There was no statistically significant differences ($p<0.05$) for any of the treatments including the control for the winter. During spring the organic plot had a significantly higher abundance ($p=0.021849$) than the conventionally treated plot, but not higher than the control plot. The control did not differ significantly from either of the conventional or organic plots. During the summer the conventional plot had a significantly lower abundance than the control plot (p=0.021849), but not the organically managed plot. During autumn all the experimental and control plots showed a higher abundance of mites, this was significantly higher (p=0.003605) than the values found for both the winter and the spring in all cases, except the organic plot. The organic plot showed no significant difference in seasonal abundance throughout the whole sampling period.

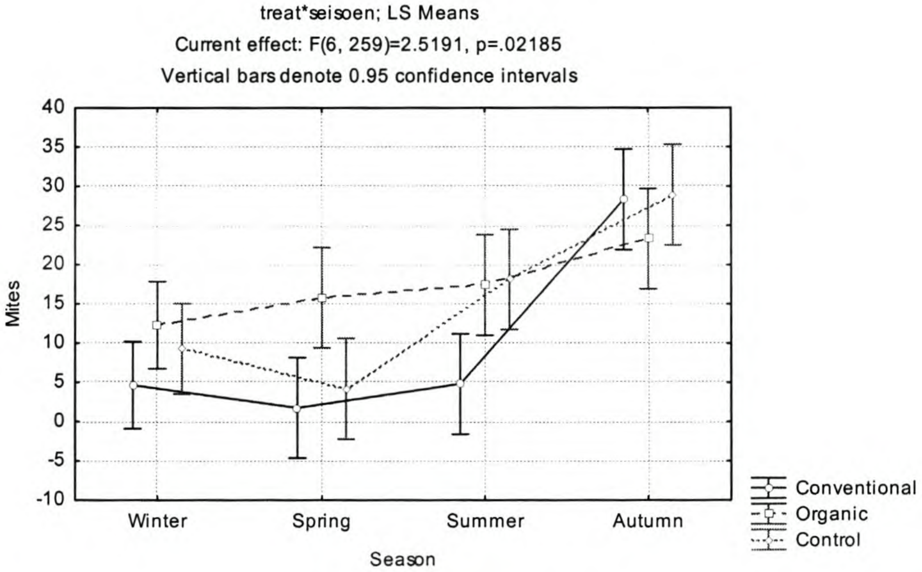

Figure 3.5: Seasonal abundances of mites (Acari) for the organic, conventional and control sites.

There was no significant difference (p=0.215256) between the abundances found for the different seasons when the total number of mesofauna was pooled together (Fig. 3.6). The total abundance was lowest during winter and highest during autumn. The abundance increased slightly in the spring from the winter levels, but decreased again during summer. Thus the total abundance of the mesofauna increased during the sampling period, but were not significantly higher (p<0.05) than when this study started.

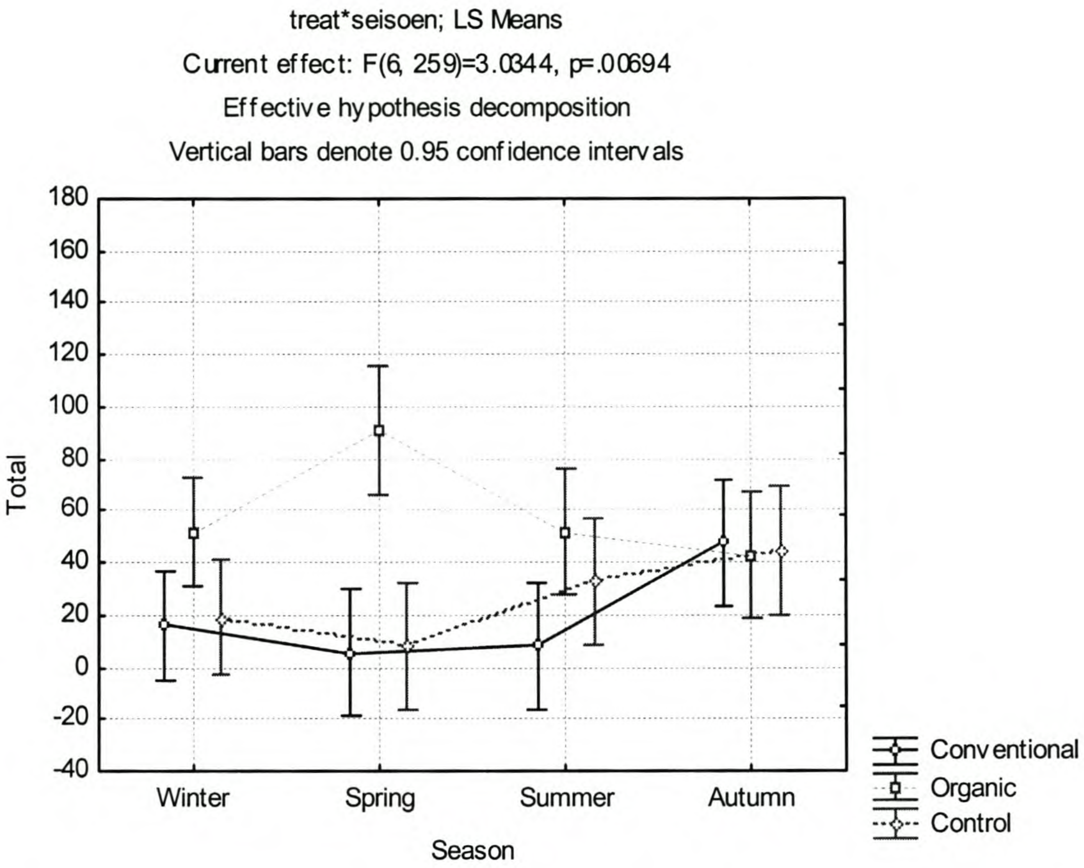

Figure 3.6: Seasonal trends in the abundance of the total number of mesofauna found for each of the experimental sites.

The greatest total abundances for the mesofauna, according to the Shannon Weiner index were found during September 2002 and December 2002 for the conventional sites, this was higher than both the organic and control sites (Fig. 3.7). The Shannon Weiner index showed a steady increase in the diversity of the mesofauna in all three the experimental sites from June 2002 to December 2002, after which the control plot decreased till June 2003. The conventional and the organic sites showed the same increase during the spring and summer months (September 2002 till December 2002), but had the lowest diversities in March 2003, after which it started to increase slightly towards June 2003.

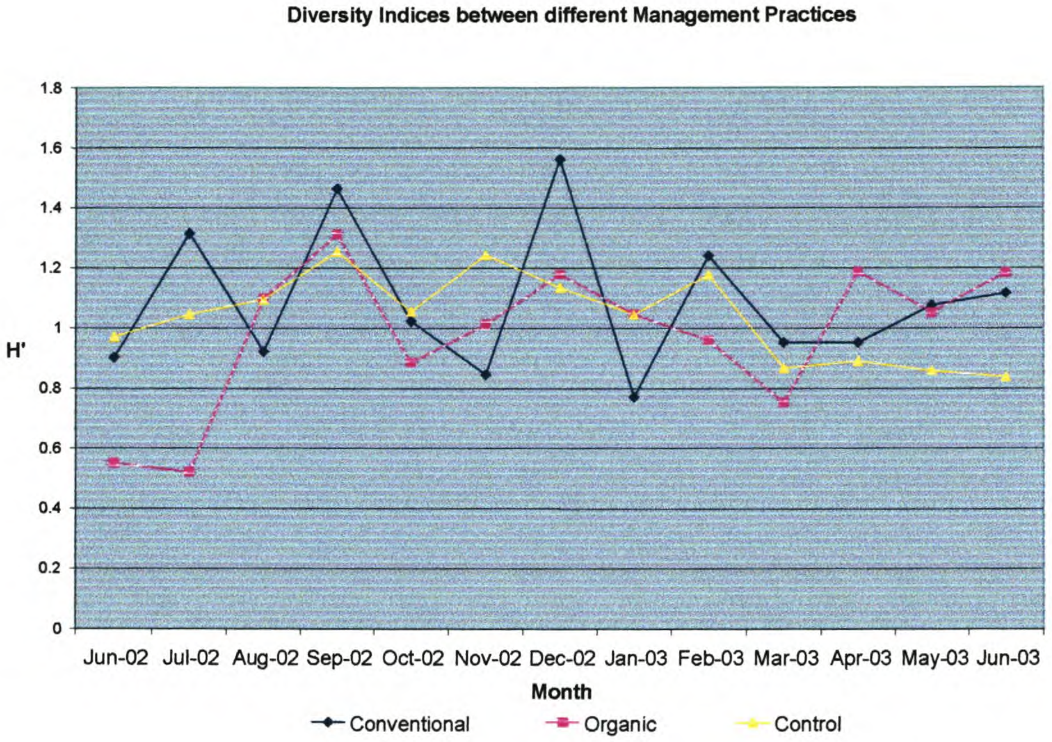

Figure 3.7: Shannon Weiner index of diversity of the mesofauna for the conventional, organic and control sites, shown on a monthly basis from June 2002 to June 2003. (See Table 3.2)

None of the experimental plots showed a particular dominance in their diversity throughout the sampling period, with the conventional site being the highest during June 2002, September 2002, December 2002, February 2003, March 2003 and May 2003. The organic site had the highest diversity index during August 2002, January 2003, April 2003 and Jun 2003. The control site showed the highest diversity on during the three months of June 2002, October 2002 and November 2002. The H' values, a measure of diversity derived from the Shannon Weiner index, for each of the sampling dates are included in Table 3.2.

Table 3.2:Individual H' values as derived from Shannon Weiner's index of diversity for the organic, conventional and control sites on which the graphic presentation (Fig. 3.7) is based.

Month	Conventional	Organic	Control
Jun-02	0.901951382	0.551799	0.970451
Jul-02	1.314373843	0.521345	1.045861
Aug-02	0.920249244	1.098544	1.095469
Sep-02	1.464816385	1.311431	1.253649
Oct-02	1.023533837	0.885231	1.054231
Nov-02	0.846017064	1.011016	1.243452
Dec-02	1.560710409	1.178772	1.134134
Jan-03	0.770023179	1.045861	1.045861
Feb-03	1.239955553	0.958928	1.176511
Mar-03	0.951342333	0.751859	0.867354
Apr-03	0.950690392	1.18812	0.889562
May-03	1.075485194	1.052618	0.85861
Jun-03	1.116349668	1.183951	0.837966

When looking at the degree of change in the abundance between the different management practices for the Poduromorpha (Fig 3.8), it is seen that when the conventional are compared to the control site it is almost always negative, showing that is in a worse ecological state than the control site. However, during October 2002, May 2003 and Jun 2003, it is shown to be in a better state ($\Delta V < 0$), having a lesser amount of disturbance than the control, but it is still in most cases in a worse condition, when compared to the organic site.

Comparing the degree of change in the abundance of Poduromorpha between the organic site and control site to that of the conventional and control (Fig. 3.8), it is in a less disturbed state than the conventional site, with ΔV values closer to 0. This is closer to the values found for the control site. The organic site is in a better state than the control ($\Delta V > 0$), with values ranging to almost 0.5 in eight of the sampled months. The highest levels of abundance were found in the late spring and early summer months. This is coherent with the increase in the diversity values as shown in Fig. 3.7 and Table 3.2.

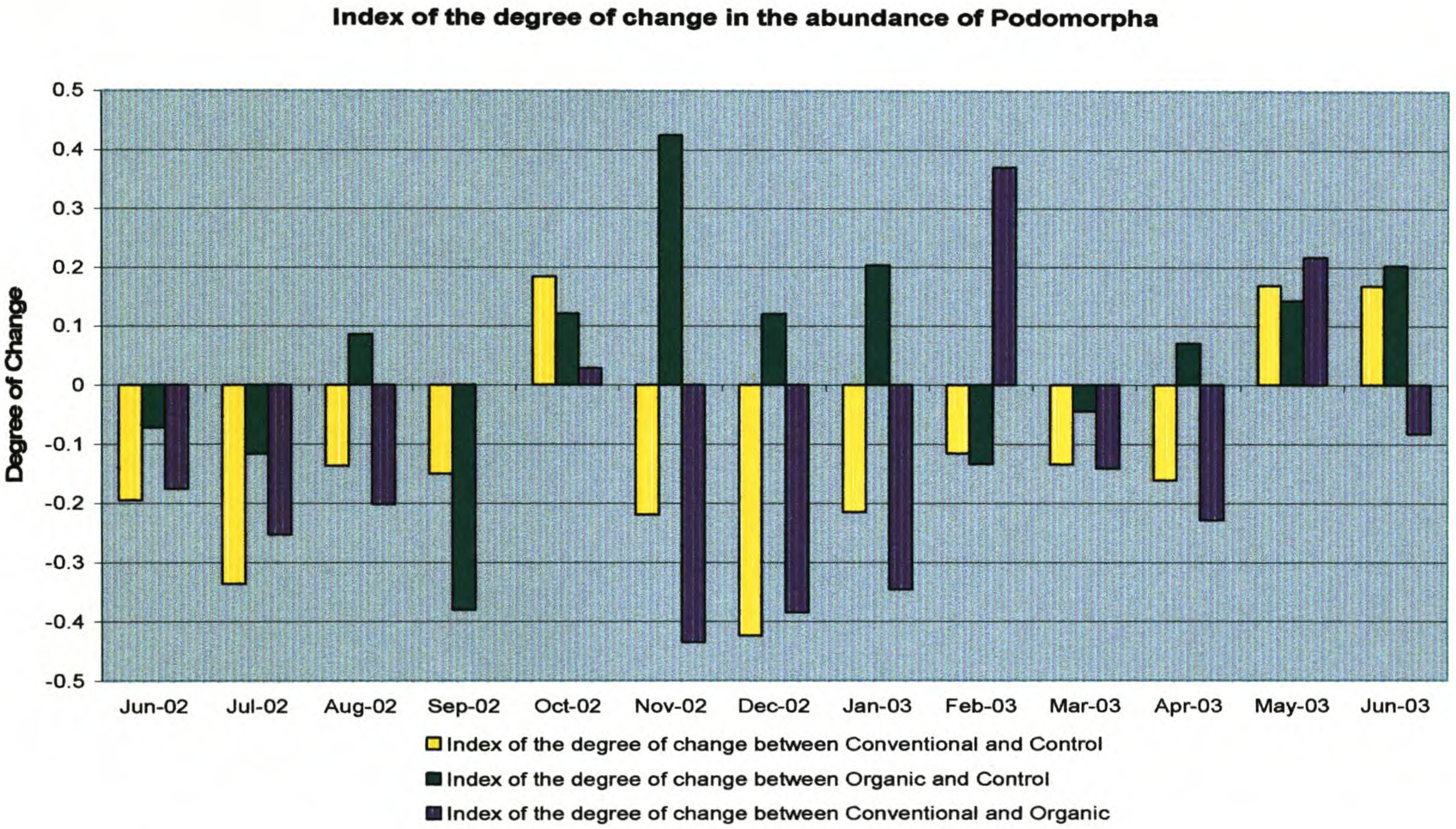

Figure 3.8: Index of the degree of change in the abundance of Podomorpha between the conventional, organic and control sites.

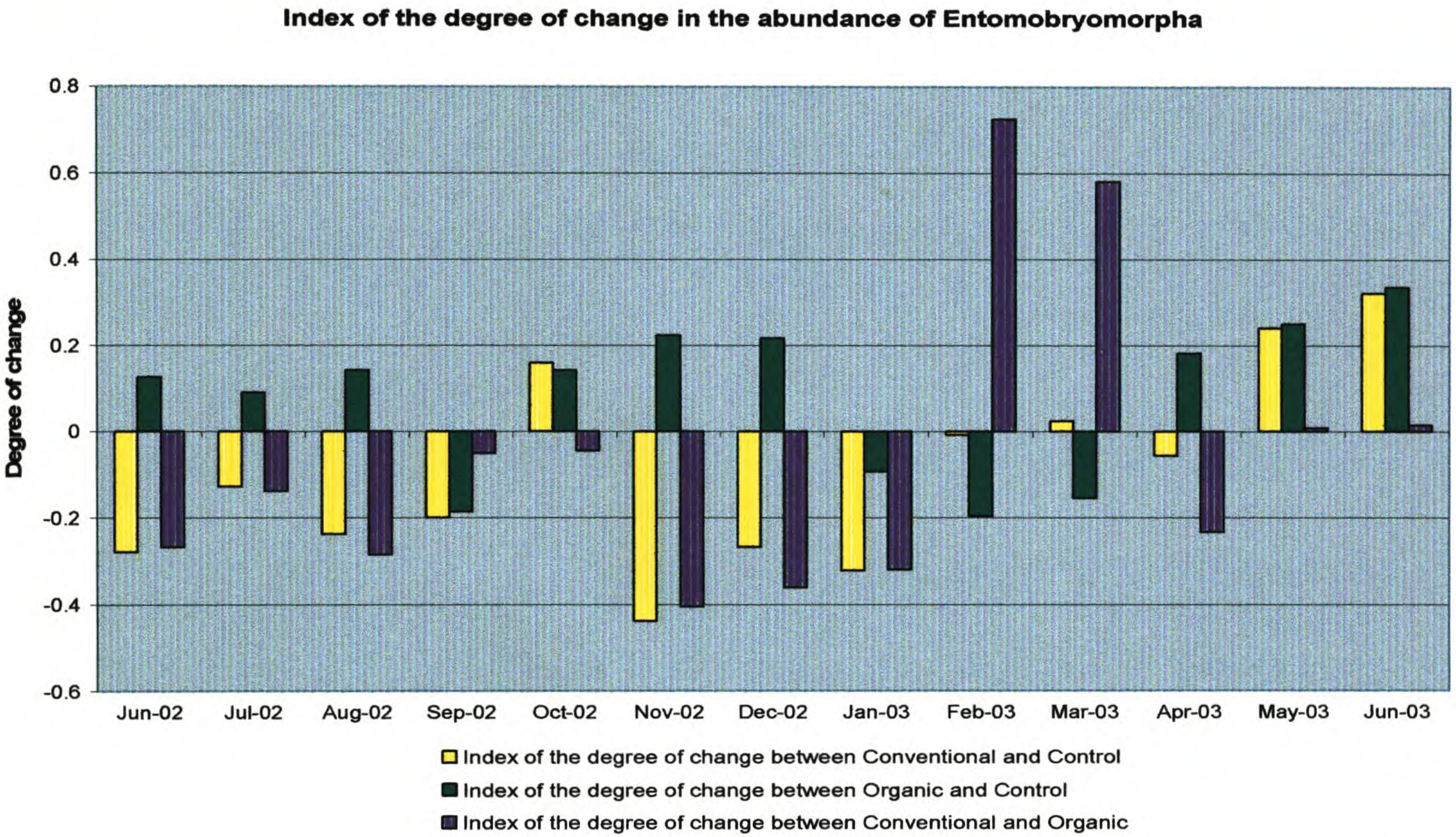

Figure 3.9: Index of the degree of change in the abundance of Entomobryomorpha between the conventional, organic and control sites.

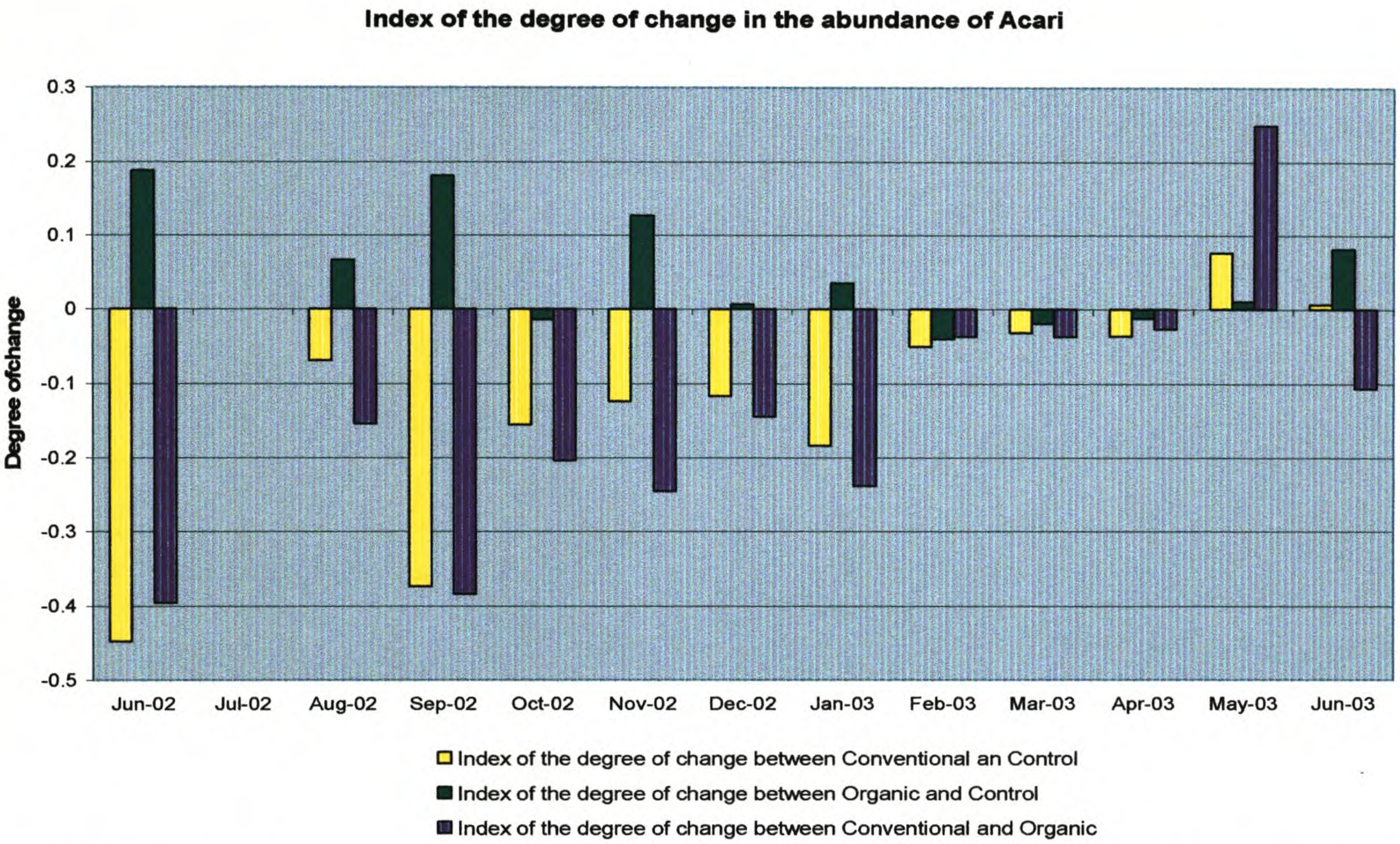

Figure 3.10: Index of the degree of change in the abundance of Acari between the conventional, organic and control sites.

When the conventional plot and the organic plot's degree of change (Fig. 3.8) are compared to each other, the conventional has a negative value in almost all the samples. The conventional site has only higher values than the organic site during October 2002, February 2003 and May 2003. During September 2002 the degree of change showed no difference between the conventional and the organic sites.

The Entomobryomorpha had a higher abundance in the organic plots during almost all the months than both the conventional and the control plots. During February and March 2003, the conventional site showed to have the highest values for abundance with values between 0.5 and 0.8 (Fig. 3.9). This was the biggest positive values for the conventional site compared to the organic site in all the samples.

During July 2002, there was no difference in the degree of change ($\Delta V = 0$) between either of the experimental plots for mites (Fig. 3.10). The mites showed a very low degree of change between the various treatments, with the majority of the values for the degree of change being between -0.1 and +0.1. The organic site showed to be in a better state than the conventional site when compared to the control in all the samples except May 2003, where the conventional site was better ($\Delta V = +0.075$).

3.3 Earthworms

The earthworms had the highest biomass during the winter and autumn in all the experimental and control site. The biomass decreased during the spring and reached the minimum during the summer sampling for all the different treatments. The earthworm biomass increased again during the autumn. There were no significant differences ($p=0.3261$) between the treatments for the different seasons. The earthworm samples were measured statistically using bootstraps, due to the data not being normally distributed. Figure 3.11 shows that there were no individuals found during the summer sampling in the conventional site. When all the different treatments are pooled together, the winter weights of the individual worms are much higher with a weight between 0.2

and 0.25g per individual and are statistically higher than the weights of less than 0.05 found in the summer. The worms are almost the same size during the autumn as during the winter sample (Fig. 3.12). The conventionally managed site had the lowest biomass for the entire sampling period, with the organically managed site higher and the control site the highest (Fig. 3.13). The control site showed a smaller standard deviation than both the experimental sites. There was however, no statistical difference between the different treatments for the earthworm samples (Fig. 3.13).

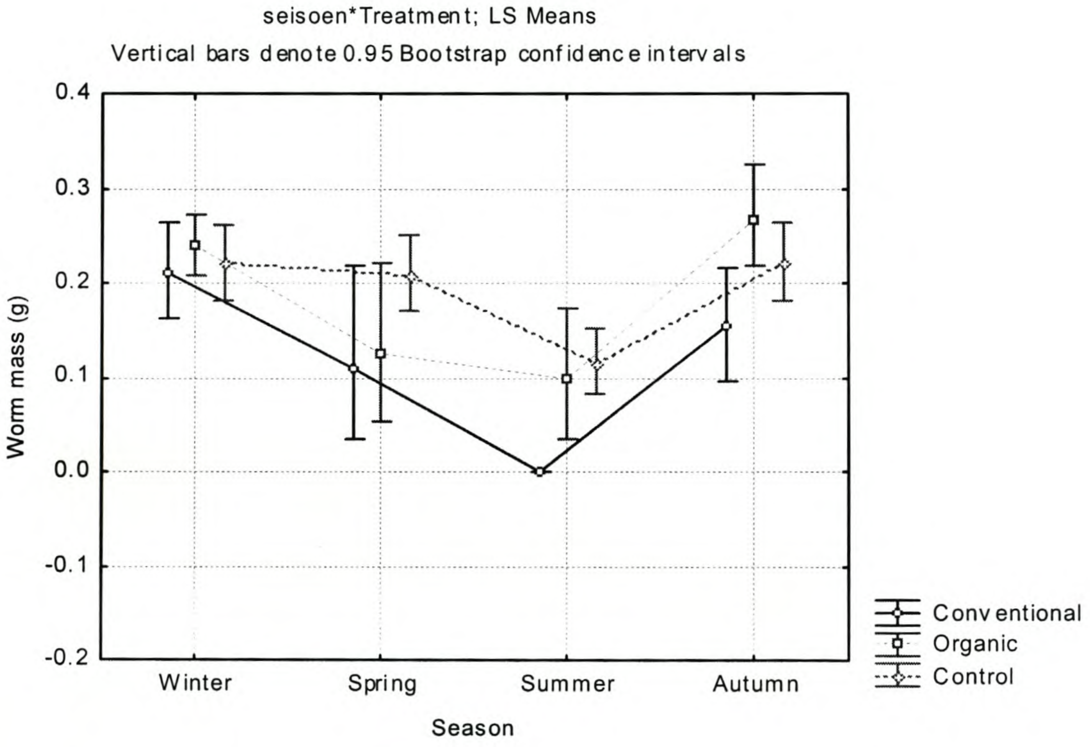

Figure 3.11: Bootstrap confidence intervals for the seasonal abundance of the earthworms found at the organic, conventional and control sites.

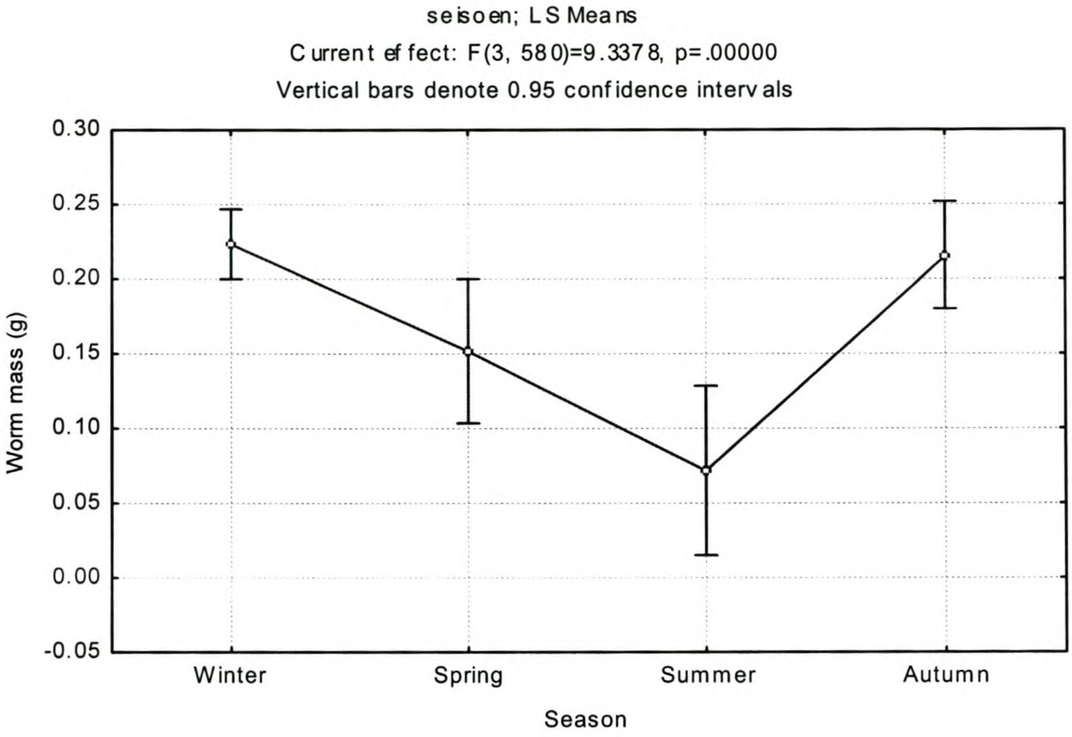

Figure 3.12: Seasonal trend for earthworm biomass, the organic, conventional and control sites' samples were pooled together for an overall trend for the entire sampling area.

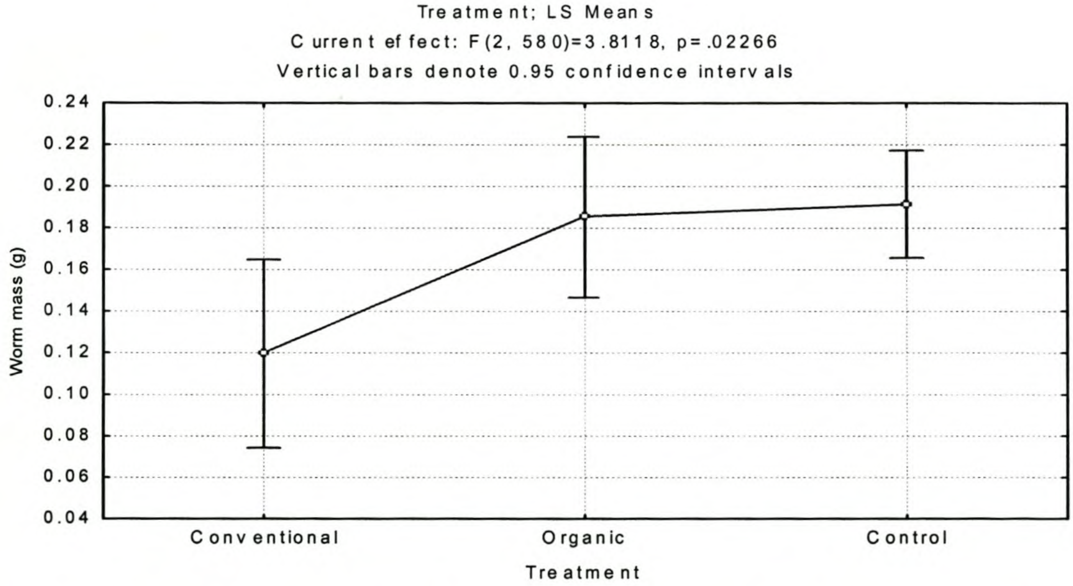

Figure 3.13: Earthworm mass for the entire sampling period (May 2002 – Jun 2003) for each of the experimental and control sites.

3.4 Biological Activity

The bait lamina results showed no significant differences between the different feeding depths for any of the different treatments or the control sites (p = 0.9885). The feeding activity in all the experimental and control sites were statistically the same for all the different feeding depths (fig. 3.14). The control site had significantly lower feeding activity than both the conventionally and organically managed sites in almost all the cases throughout the whole feeding profile. The feeding activity during the individual sampling dates indicated a slight increase in the soil biological activity towards the end of the sampling period (fig. 3.15). The lowest activity was found at the first two sampling dates and the highest activity during the last two sampling dates. When the activity of each of the experimental and the control plots are pooled together, the soil biological activity shows to be statistically much higher (p = 0.0173) in the experimental plots than that of the control plot (fig. 3.16). There is no statistical difference between the feeding activity in the conventional and organic plots.

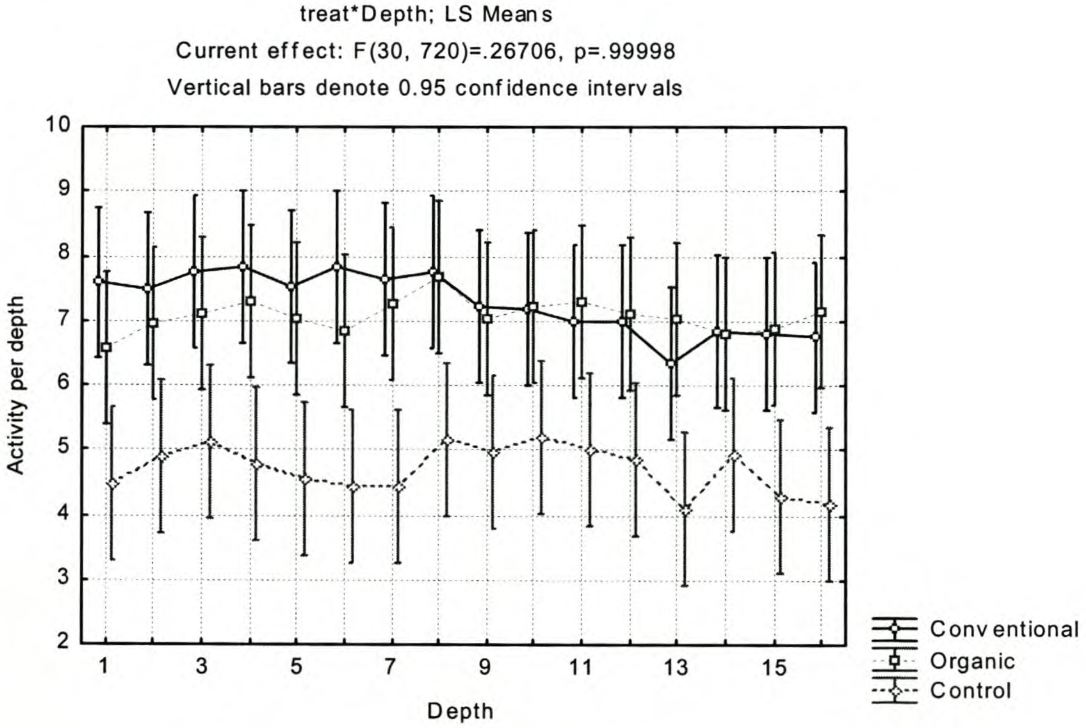

Figure 3.14:Feeding activity per depth of bait lamina for the conventional, organic and control sites.

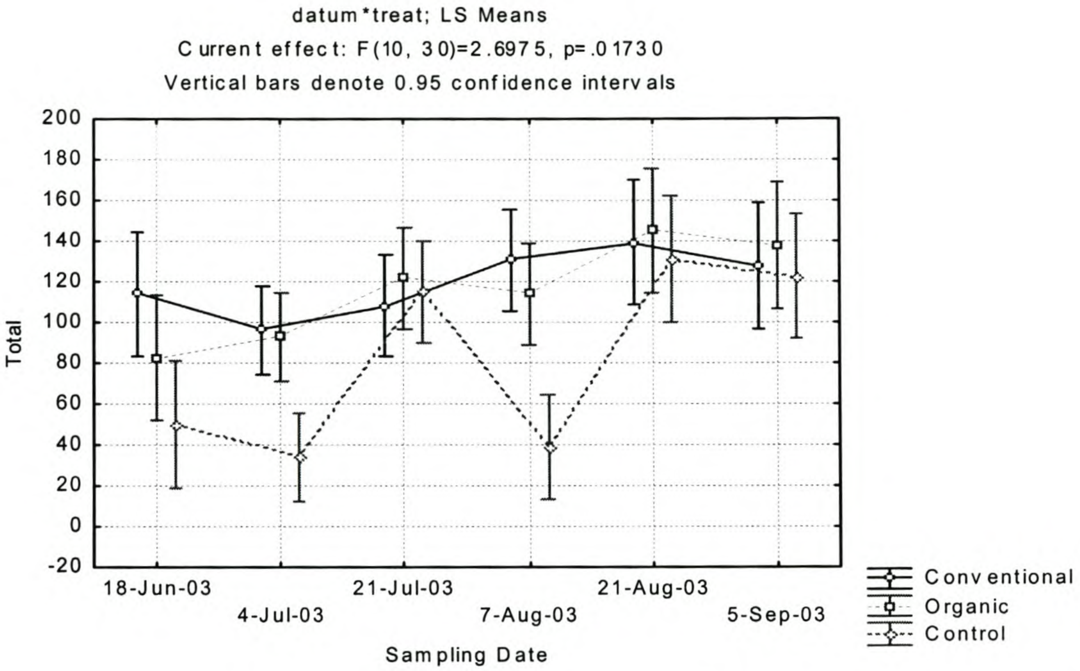

Figure 3.15: Feeding activity on bait lamina for conventional, organic and control sites for the individual sampling dates.

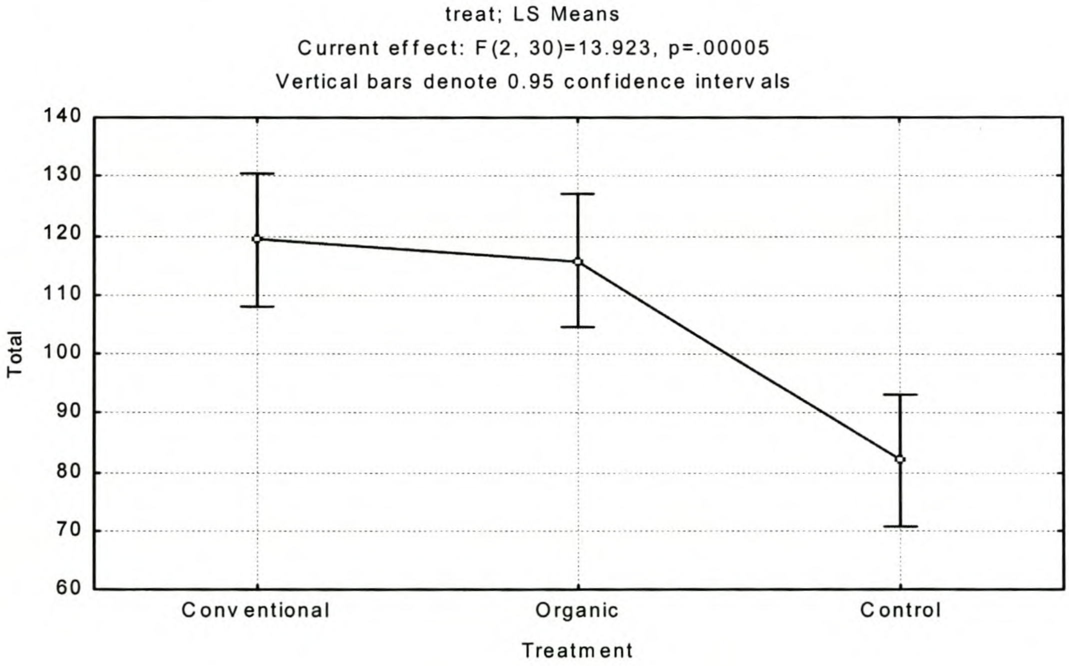

Figure 3.16: Total activity as measured with the bait lamina technique for the conventional, organic and control sites over the entire sampling period.

The litter-bag experiment showed the same results than the bait lamina. The conventional (p = 0.000385) and organic sites (p = 0.000675) both had a significantly higher amount of activity than the control site. Both the experimental sites showed a 30 to 40% decrease in the weight from when the litter-bags were buried in the soil. The control plot showed a significantly lower amount of decomposition, with only a 15 to 25% weight loss for the same period (fig. 3.17).

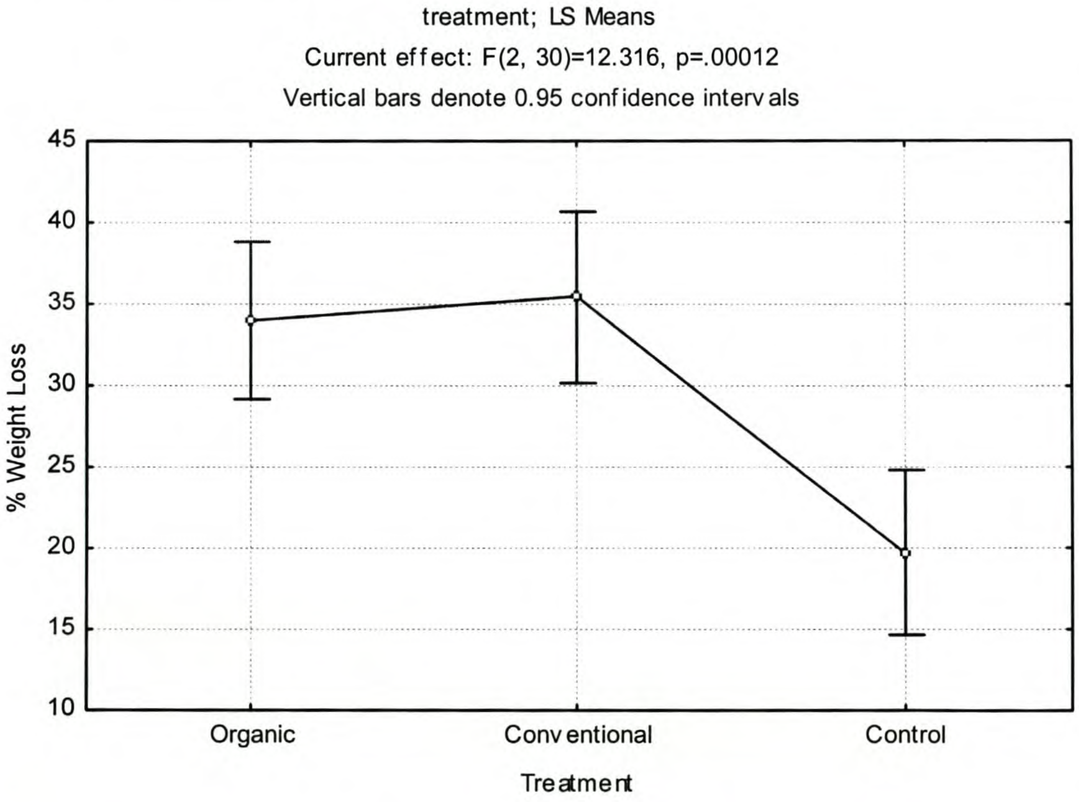

Figure 3.17: Percentage weight loss in litter-bags in the different experimental and control sites.

The CO_2-flux (Fig 18) in the soil, used as a measure of soil respiration and soil biological activity, showed the same trend as seen in the diversity indices and the measure of change in abundance for the different sites. Both the soil incubated at 20°C and 35°C showed a trend for the biological activity which would be expected if one consider the abundance data, but totally the inverse from the actual biological activity measurements. The activity was lowest in the conventionally treated soil (values between 0.2 and 0.4 ppm

CO_2) and highest in the soil from the control site (values between 0.6 and 1.2 ppm CO_2). The soil incubated at 20°C, related to the winter conditions, showed the highest levels of activity for all three the experimental plots, this was coherent with the increase in the diversity indexes during the winter months.

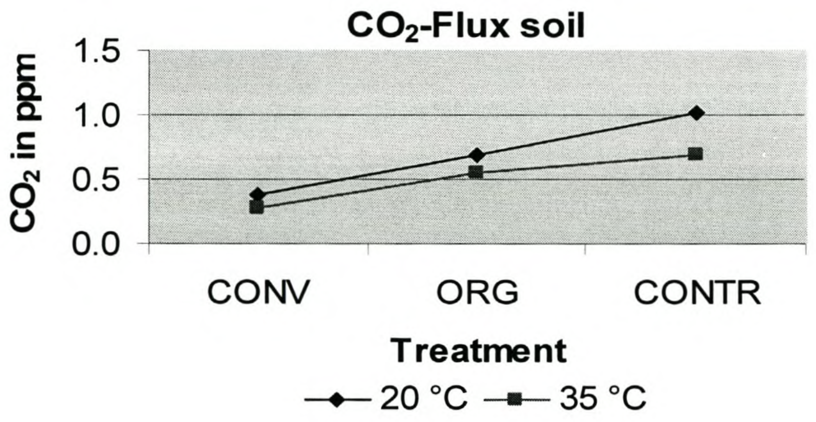

Figure 3.18: CO_2-Flux as an indication of the soil respiration and biological activity of soils from the conventional, organic and control plots, incubated at 20°C and 35°C to simulate summer and winter conditions.

4 Discussion:

Seasonal variation in species abundance of Collembola had been observed on many occasions; however, most eudaphic and hemicdaphic species of Collembola may reproduce during any favourable period throughout the year (Lavelle & Spain 2001). This can be accepted for this study since both the Poduromorpha and the Entomobryomorpha showed stable abundances throughout the entire sampling period for both the conventional and the control plots.

Petersen (2002) stated that lower densities of Collembola were generally found in conventionally grown cultivated fields supplied with chemical fertilizer than for natural or semi-natural soils. This seemed to not only affect the population densities, but also the individual weights of the animals and consequently also the biomass, which were lower in conventionally cultivated soils than in uncultivated soils, however, organically cultivated soils had higher numbers and biomass (Petersen 2002).

The Poduromorpha abundance appeared to be the highest in the organically managed plot in all the cases, but was in fact only significantly higher than the other treatments during the spring sampling. The Poduromorpha density increased from winter to spring and decreased again during summer and autumn sampling sessions. However, the Poduromorpha abundance stayed stable in the other plots.

When all the Collembola were pooled together the seasonal abundance follows the same trend as the Poduromorpha samples showed. The abundance of the conventionally managed and the control plots showed a slight decrease from the winter season, which is the wet season in the Western Cape, towards the summer samples. The abundances of the Collembola increased again slightly during the autumn. The organically managed plot, however, showed a significant increase towards the spring, after which it decreased consistently towards the autumn. This trend in the overall Collembola data can be attributed to the increase in the Poduromorpha, which was the most abundant of the Collembola found in this study.

The Poduromorpha proved to be the most abundant in the organic site compared to the other experimental sites. This could be ascribed to the sharp increase of this group during the spring samples. There were no statistical differences between the abundances of the conventional and the control sites, and thus the presence of pesticides did not appear to have had an influence on the abundance of this group. The organic farming methods did however have a positive effect on the abundance of this group of Collembola, as seen in the earlier results.

When the seasonal abundances of Collembola within the differently treated plots and the control plot are compared with those of mites at this study site, a similar trend was observed with the high abundances at the organic plot during the spring sample. The mites however, started at low abundances during the winter sampling and increased towards the following year's autumn samples. This occurred within both the experimental and the control plots. This could be due to higher moisture content during the autumn as opposed to the previous winter. The different management practices did not seem to have a distinct effect in either of these groups of mesofauna. A comparison between Collembola and oribatid mites, two groups with similar habitat and food requirements, suggested that Collembola are usually more dominant in disturbed or agricultural soils, where as the mites favoured more stable environments with high organic matter content and generally low pH (Petersen 2002). Neither of these two groups proved to be dominant over the other, with the mites only being statistically more abundant during the autumn samples. This was however the end of our sampling period and further studies are needed to assess if this trend was permanent or only due to fluctuations of the current rainy season.

Mites and Collembola abundances depend predominantly on the amount and variety of available food. Collembola are mainly fungivorous, but feeding on bacteria, plant debris, green plants and predaceous feeding behaviour have also been observed (Larink 1997). The different taxa of mites show a high diversity of nourishment including carnivorous, fungivorous and feeding on decaying leaf litter (Larink 1997).

Pesticides influence soil-fauna and especially Collembola and mites. These however seem to have only short term effects and the populations usually recover within one to three months from the application of the pesticide (Larink 1997). Heupel (2002) tested the avoidance response of five species of Collembola to Betanal. All five of the tested species showed significant avoidance of this pesticide, thus it can be assumed that the Collembola will move away to avoid contact with the pesticide. This will have a negative effect on the abundance and diversity of a particular community. This was, however, not found to be true in this study, with the abundance of Collembola in the conventional site, which was sprayed with pesticides, being no different from the abundance found in the control site, which had no pesticide application.

In another study it was shown that a Collembola species, *Folsomia fimetaria*, had a change in behavior to certain insecticides (Petersen & Gjelstrup 1998). It was even shown in the same study that some of the individuals, showed signs of avoidance reactions to the pesticide. It is thus thought that this species may have a limited ability to avoid pesticides by escaping from contaminated parts to less contaminated parts in the soil (Petersen & Gjelstrup 1998). Thus the type of pesticides used may have a great effect on the mesofaunal abundance and diversity. This however did not seem to be an inhibiting factor in this study, with both the Collembola and the mites showing no statistical difference between any of the experimental and control plots. This might mean that other abiotic factors such as soil moisture might have a greater inhibiting effect than the pesticides used on this farm.

The earthworm biomasss decreased during the spring and the summer months when there was less soil moisture available. This happened in all the experimental and the control plots. The organic plot had more earthworms present in almost all the samples. This could be attributed to the higher amount of organic material present in this plot, since the main source of organic material on which earthworms feed is litter from above ground plant parts (Curry 1998). The organically farmed plot had a higher organic content than the conventional plot. According to Curry (1998), earthworm populations are generally lower in arable land than those in undisturbed habitats, but this prove not to be true in this study. There were no significant differences between the different treatments, although the control plot had slightly higher earthworm abundances. The number of earthworms in the farmed plots could be comparable with those in the control plot due to moisture retaining methods rather than differences in organic matter or the farming methods between the organic and conventional plots.

The only two species of earthworms present in the soil of both the experimental and the control plots were *Eisenia rosea* and *Aporectodea calliginosa*. These species appear to be less affected by farming practices and may even benefit from it (Edwards 1983). Both these are European species that were introduced to South Africa. This is an aspect of human intervention that have the potential to be detrimental to local indigenous earthworm populations (Curry 1998), as can be seen in this case with no indigenous species being found throughout the entire sampling period.

Curry (1998) proposed that there is a lot possibility for earthworm diversity and activity through the use of different management practices, such as organic farming, that remove the constraints of abiotic factors like low pH and unfavorable moisture conditions. These methods minimize the inhibiting effects of cultivation and pesticides and increase the food supply by increased organic input and increased crop residue return to the soil. Werner & Dindal (1989) reported that manure amendments supported higher earthworm densities and biomass than inorganic fertilizers after five years of soy-bean – corn – legume rotations. It was also stated that in long-term continuous cereal production, earthworm abundance and biomass was greatest in plots receiving a combination of manure and inorganic fertilizer (Edwards & Lofty 1982). This, however, did not prove to be true in this study. There were no statistical differences between the abundances of any of the experimental and the control sites throughout the entire sampling period.

The earthworms showed a clear seasonal abundance pattern with the abundance being statistically higher during the winter and autumn than during the drier summer months. Taking this into account, it is possible to suggest that the stress put on the earthworm community at Plaisir de Merle due to moisture content in the soil may have a larger effect than that of the pesticides. Although the conventionally farmed site has lower numbers than the organically farmed and the control sites, the differences are not statistically different between these sites. It is well documented that earthworm populations and biomass are significantly affected by soil temperature and moisture, and in temperate agro-systems, earthworms are usually more active during spring and autumn (Whalen *et al.* 1998). Baker *et al.* (1993) reported that in South Australia, introduced earthworms were only active during the autumn and spring months and only in the top 10cm of the soil.

The optimal temperatures for growth of earthworms vary from species to species, but the range can be rather narrow. The upper lethal temperatures for earthworms are lower than for many other soil invertebrates. The upper lethal temperature for *A. calliginosa* is stated to be only 26ºC (Edwards & Bohlen 1996), which is lower than the average summer temperature for these experimental plots. The earthworms, however, are known to migrate deeper in the soil due to temperature and moisture stress (Chan 2001). This could have been an important factor resulting in the low numbers found during the summer sampling. The sampling method only went to a fixed depth of 30cm, and did not record the number of cocoons found; only living individuals were counted. This was also mentioned by Schmidt and Curry (2001) as being a possible reason for under estimation of the levels of earthworm populations during their study, since there are several species of earthworms that are capable of burrowing deeper than the sampling depth. It is even possible that some might be aestivating or in diapause in deeper soil layers during stressful times.

While the earthworm numbers and biomass are influenced primarily by soil temperature and moisture availability, cultivation and fertilizer amendments can influence the temperature and the water holding capacity of soils and the ability to support earthworm communities (Whalen *et al.* 1998). This was not shown clearly in this study.

The feeding activity on the bait lamina in the control site was much lower than in both the conventionally and organically managed sites. All the experimental and the control sites showed a slight increase in the feeding activity on the bait lamina towards the end of the sampling period. Even though the organic plot showed a slightly lower feeding activity than that found in the conventional block, it was not significantly lower. There were no significant differences between the feeding activities at any given depth throughout the whole feeding profile. This was not coherent with previous studies, e.g. Paulus *et al.* (1999), where there was a distinct decrease in the feeding activity due to soil depth. These studies showed feeding activity to be high close to the surface with a decrease in the activity as you went deeper. However the feeding activity was not related to pesticide use, where the conventional site is known to have pesticides present and the organically managed site not. Both these experimental sites showed higher feeding activity than in the control site with natural vegetation and no known history of agriculture. Reinecke *et al.* (2002) showed that soil treatments that contained herbicides actually have a beneficial effect on the feeding activity of soil fauna on bait lamina. They however stated that whether it is a direct effect due to the herbicide application or whether it was due to some other associated factor was not possible to derive from their data. The occurrence of higher biological activity in the presence of certain herbicides was also earlier noted by Edwards and Stafford (1979).

In this study soil moisture might have played a more important role in the feeding activity than the pesticides used in the differently managed vineyard blocks. Both the organically managed and conventionally managed sites had water retaining methods in place in the form of a straw covering on top of the soil between the vines. The control site has the lowest feeding activity at almost all the sampling dates; this was the only site without any cover crop or water retaining methods present. The presence of the cover crop also had a notable influence on the feeding activity of soil fauna on bait lamina according to the results found by Reinecke *et al.* (2002).

Larink and Sommer (2002) showed that there was high biological activity in the presence of high soil moisture levels. The mean feeding activity found in their experiment was above 60%. Their results were coherent with the findings of this study in the conventional and organic plots at Plaisir de Merle. According to Gongalsky *et al.* (2004) abiotic factors seem to be much more important for the explanation of bait lamina test perforation results than the abundance and diversity of soil macrofauna.

The litter bags showed most significant differences between the decomposition activity measured in the organically and conventionally managed sites, but the significantly lower activity was measured in the control site. This could be due to the method used to maintain soil moisture, like the presence of a cover crop and straw cover to prevent evaporation.

Paulus *et al.* (1999) found that the presence of agricultural chemicals hardly cause any change in the decomposition rates. This was evident in this study as well, but both the litter bags and the bait lamina tests showed the same trend, with higher activity in the experimental plots than in the control plot. The litter bags had a 30% to 40% weight loss in the organic plots after an exposure time of 3 months, where as the control only showed 15% to 25% weight loss during the same time period.

This rate of decomposition was much faster than decomposition rates determined by Hansen and Coleman (1998) in the Northern hemisphere. After nine months of exposing the litter bags in the soil, the litter bags only showed between a 29% and 40% decrease from the starting weight.

Cortet *et al.* (2002) found significant differences in the decomposition activity in plots sprayed with pesticides as apposed to herbicides. The herbicide treated plants showed much higher activity than the plots sprayed with insecticide. This is thought to be due to the fact that certain micro-organisms use herbicides as a source of energy. This was confirmed by high microbial biomass after their study. This provides us with a hypothesis that the agricultural methods used at Plaisir de Merle might have a positive effect on the biological activity, as our results for the bait lamina and litter bags showed.

The CO_2-flux, a measure of soil respiration and biological activity, however did not correspond with the other measurements of biological activity taken during this study. The soil used for the CO_2-flux was incubated at both 20ºC and 35ºC for summer and winter temperatures. Both these simulations had the same trend. The conventionally managed site showed lowest activity and the control site the highest. The soil respiration levels were highest during the winter simulation for both the experimental sites as well as the control site. The difference between the respiration levels found in the seasonal simulations was most evident in the control site, with the summer resulting in a much lower activity level than that of the winter simulation, relating to the trend shown by the other treatments.

Seasonal variation in soil respiration is thought to be largely explained by soil temperature and water content in some areas such as areas with a Mediterranean climate (Epron *et al.* 2004). However it are the micro-organisms along with the meso- and macrofauna in the soil that convert soil organic carbon to CO_2 through their metabolic activities. It is thought that Collembola typically only contribute between 1% and 5% of soil respiration in temperate ecosystems (Hopkin 1997). As decomposers the importance of micro organisms in soil organic matter transformations and soil respiration must be recognised (Wang *et al.* 2003). Studies have shown that microbial biomass is very responsive to the input of organic materials and to soil management practices. If soil has been under stabilised conditions for a long period, the microbial biomass may reach equilibrium with the organic C in the soil.

The rate of soil respiration under favourable temperature and moisture condition is generally limited by the supply of biologically available substrate rather than the size of microbial biomass (Wang *et al.* 2003). Thus according to those findings, it is possible that the CO_2 flux might be coherent with the bait lamina and litter bag results, because the control site had a higher percentage of organic matter than the conventional and organic sites.

5 Conclusions:

- It was concluded that there were no significant differences in the abundance and the diversity of the meso- and macrofauna between the different management practices used at Plaisir de Merle during this study. It is recommended that further studies should be done, because the present study only represented one growing season and the farm has been using organic management practices for less than a decade.

- There were no significant differences between the effects of the various management practices (organic, conventional and control) on the biological activity in the soil of Plaisir de Merle during this study. Further long term studies on the biological activity in these vineyards might prove worthwhile to provide a clearer representation of the biological activity in terms of decomposition rates, soil respiration and feeding activity.

- This study has shown that the use of organic or conventional farming methods can have an effect on soil biodiversity, but it could not prove conclusively whether there was a substantial affect on the abundance and diversity of the soil meso- and macrofauna investigated. Because there were no significant differences between the organically farmed and the conventionally farmed sites, it is not possible to propose that organic farming is better for soil biodiversity and soil functionality than conventional farming practices.

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7 Appendix A: Raw Data

Table 1: Raw data for Mesofauna samples collected at Plaisir de Merle from June 2002 till June 2003.

Treatment	Month	Season	Sample #	Total	Poduromorpha	Entomobryomorpha	Mite	Othe
Conventional	Jun-02	Winter	1	5	5	0	0	0
Conventional	Jun-02	Winter	2	0	0	0	0	0
Conventional	Jun-02	Winter	3	0	0	0	0	0
Conventional	Jun-02	Winter	4	4	4	0	0	0
Conventional	Jun-02	Winter	5	3	3	0	0	0
Conventional	Jun-02	Winter	6	3	0	3	0	0
Conventional	Jun-02	Winter	7	2	1	1	0	0
Organic	Jun-02	Winter	1	26	2	18	6	0
Organic	Jun-02	Winter	2	48	11	29	8	0
Organic	Jun-02	Winter	3	12	0	7	5	0
Organic	Jun-02	Winter	4	221	3	218	0	0
Organic	Jun-02	Winter	5	17	3	14	0	0
Organic	Jun-02	Winter	6	99	14	85	0	0
Organic	Jun-02	Winter	7	49	11	29	9	0
Control	Jun-02	Winter	1	9	1	3	5	0
Control	Jun-02	Winter	2	11	5	6	0	0
Control	Jun-02	Winter	3	22	15	7	0	0
Control	Jun-02	Winter	4	35	21	14	0	0
Control	Jun-02	Winter	5	9	8	1	0	0
Conventional	Jul-02	Winter	1	1	0	1	0	0
Conventional	Jul-02	Winter	2	0	0	0	0	0
Conventional	Jul-02	Winter	3	0	0	0	0	0
Conventional	Jul-02	Winter	4	1	0	1	0	0
Conventional	Jul-02	Winter	5	4	2	2	0	0
Conventional	Jul-02	Winter	6	1	0	1	0	0
Conventional	Jul-02	Winter	7	0	0	0	0	0
Organic	Jul-02	Winter	1	24	8	16	0	0
Organic	Jul-02	Winter	2	10	1	9	0	0
Organic	Jul-02	Winter	3	5	2	3	0	0
Organic	Jul-02	Winter	4	35	6	29	0	0
Organic	Jul-02	Winter	5	16	1	15	0	0
Organic	Jul-02	Winter	6	4	1	3	0	0
Organic	Jul-02	Winter	7	92	9	83	0	0
Control	Jul-02	Winter	1	9	7	2	0	0
Control	Jul-02	Winter	2	30	9	10	11	0
Control	Jul-02	Winter	3	14	2	3	9	0
Control	Jul-02	Winter	4	3	0	0	3	0
Control	Jul-02	Winter	5	10	3	0	7	0
Control	Jul-02	Winter	6	15	8	2	5	0
Control	Jul-02	Winter	7	50	6	22	22	0
Conventional	Aug-02	Winter	1	3	0	1	2	0

Conventional	Aug-02	Winter	2	3	0	0	3	0
Conventional	Aug-02	Winter	3	6	1	0	5	0
Conventional	Aug-02	Winter	4	7	2	0	5	0
Conventional	Aug-02	Winter	5	9	0	1	8	0
Conventional	Aug-02	Winter	6	2	0	0	2	0
Conventional	Aug-02	Winter	7	7	2	1	4	0
Organic	Aug-02	Winter	1	55	18	14	23	0
Organic	Aug-02	Winter	2	21	0	13	8	0
Organic	Aug-02	Winter	3	16	2	9	5	0
Organic	Aug-02	Winter	4	34	17	8	9	0
Organic	Aug-02	Winter	5	46	12	18	16	0
Organic	Aug-02	Winter	6	16	1	10	5	0
Organic	Aug-02	Winter	7	105	11	48	46	0
Control	Aug-02	Winter	1	13	6	3	4	0
Control	Aug-02	Winter	2	22	9	3	10	0
Control	Aug-02	Winter	3	8	0	1	7	0
Control	Aug-02	Winter	4	3	0	2	1	0
Control	Aug-02	Winter	5	5	0	1	4	0
Control	Aug-02	Winter	6	33	11	3	19	0
Control	Aug-02	Winter	7	26	14	4	8	0
Conventional	Sep-02	Spring	1	0	0	0	0	0
Conventional	Sep-02	Spring	2	1	1	0	0	0
Conventional	Sep-02	Spring	3	0	0	0	0	0
Conventional	Sep-02	Spring	4	1	1	0	0	0
Conventional	Sep-02	Spring	5	2	0	2	0	0
Conventional	Sep-02	Spring	6	0	0	0	0	0
Conventional	Sep-02	Spring	7	0	0	0	0	0
Organic	Sep-02	Spring	1	0	0	0	0	0
Organic	Sep-02	Spring	2	0	0	0	0	0
Organic	Sep-02	Spring	3	2	0	0	2	0
Organic	Sep-02	Spring	4	1	0	0	1	0
Organic	Sep-02	Spring	5	0	0	0	0	0
Organic	Sep-02	Spring	6	1	0	0	1	0
Organic	Sep-02	Spring	7	4	0	3	1	0
Control	Sep-02	Spring	1	4	0	4	0	0
Control	Sep-02	Spring	2	0	0	0	0	0
Control	Sep-02	Spring	3	3	0	0	3	0
Control	Sep-02	Spring	4	6	4	2	0	0
Control	Sep-02	Spring	5	2	0	2	0	0
Control	Sep-02	Spring	6	5	5	0	0	0
Control	Sep-02	Spring	7	2	2	0	0	0
Conventional	Oct-02	Spring	1	22	5	16	1	0
Conventional	Oct-02	Spring	2	3	1	2	0	0
Conventional	Oct-02	Spring	3	7	3	4	0	0
Conventional	Oct-02	Spring	4	6	1	3	2	0
Conventional	Oct-02	Spring	5	1	0	1	0	0
Conventional	Oct-02	Spring	6	17	13	4	0	0
Conventional	Oct-02	Spring	7	10	6	3	1	0

Organic	Oct-02	Spring	1	99	17	80	2	0
Organic	Oct-02	Spring	2	40	1	38	1	0
Organic	Oct-02	Spring	3	3	0	1	2	0
Organic	Oct-02	Spring	4	3	0	0	3	0
Organic	Oct-02	Spring	5	0	0	0	0	0
Organic	Oct-02	Spring	6	8	1	2	5	0
Organic	Oct-02	Spring	7	27	21	2	4	0
Control	Oct-02	Spring	1	0	0	0	0	0
Control	Oct-02	Spring	2	0	0	0	0	0
Control	Oct-02	Spring	3	2	1	0	1	0
Control	Oct-02	Spring	4	0	0	0	0	0
Control	Oct-02	Spring	5	31	5	2	24	0
Control	Oct-02	Spring	6	13	1	5	7	0
Control	Oct-02	Spring	7	12	0	8	4	0
Conventional	Nov-02	Spring	1	0	0	0	0	0
Conventional	Nov-02	Spring	2	5	0	0	1	4
Conventional	Nov-02	Spring	3	0	0	0	0	0
Conventional	Nov-02	Spring	4	3	0	0	3	0
Conventional	Nov-02	Spring	5	22	0	0	20	2
Conventional	Nov-02	Spring	6	10	0	0	3	7
Conventional	Nov-02	Spring	7	7	0	0	6	1
Organic	Nov-02	Spring	1	123	10	43	61	9
Organic	Nov-02	Spring	2	56	2	11	31	12
Organic	Nov-02	Spring	3	103	4	71	17	11
Organic	Nov-02	Spring	4	27	12	5	3	7
Organic	Nov-02	Spring	5	546	463	49	24	10
Organic	Nov-02	Spring	6	541	397	46	88	10
Organic	Nov-02	Spring	7	322	209	11	86	16
Control	Nov-02	Spring	1	14	0	8	4	2
Control	Nov-02	Spring	2	38	3	5	24	6
Control	Nov-02	Spring	3	15	1	0	8	6
Control	Nov-02	Spring	4	4	0	0	4	0
Control	Nov-02	Spring	5	5	0	1	3	1
Control	Nov-02	Spring	6	3	0	0	2	1
Control	Nov-02	Spring	7	10	6	0	4	0
Conventional	Dec-02	Summer	1	1	0	0	1	0
Conventional	Dec-02	Summer	2	2	0	0	2	0
Conventional	Dec-02	Summer	3	2	0	0	2	0
Conventional	Dec-02	Summer	4	9	0	0	4	5
Conventional	Dec-02	Summer	5	2	0	0	2	0
Conventional	Dec-02	Summer	6	1	0	0	1	0
Conventional	Dec-02	Summer	7	1	0	0	1	0
Organic	Dec-02	Summer	1	53	4	24	19	6
Organic	Dec-02	Summer	2	124	92	12	18	2
Organic	Dec-02	Summer	3	10	1	3	4	2
Organic	Dec-02	Summer	4	60	5	44	11	0
Organic	Dec-02	Summer	5	29	0	19	10	0
Organic	Dec-02	Summer	6	58	18	7	30	3

Organic	Dec-02	Summer	7	195	149	16	15	15
Control	Dec-02	Summer	1	35	8	4	19	4
Control	Dec-02	Summer	2	45	1	10	30	4
Control	Dec-02	Summer	3	56	1	8	37	10
Control	Dec-02	Summer	4	13	1	3	7	2
Control	Dec-02	Summer	5	10	2	2	5	1
Control	Dec-02	Summer	6	12	2	2	7	1
Control	Dec-02	Summer	7	15	1	2	7	5
Conventional	Jan-03	Summer	1	5	0	0	5	0
Conventional	Jan-03	Summer	2	0	0	0	0	0
Conventional	Jan-03	Summer	3	7	0	3	4	0
Conventional	Jan-03	Summer	4	2	0	0	2	0
Conventional	Jan-03	Summer	5	8	0	0	8	0
Conventional	Jan-03	Summer	6	1	0	0	0	1
Conventional	Jan-03	Summer	7	10	0	0	10	0
Organic	Jan-03	Summer	1	281	241	4	34	2
Organic	Jan-03	Summer	2	15	1	2	12	0
Organic	Jan-03	Summer	3	14	2	0	12	0
Organic	Jan-03	Summer	4	15	0	2	13	0
Organic	Jan-03	Summer	5	49	1	0	48	0
Organic	Jan-03	Summer	6	35	3	6	25	1
Organic	Jan-03	Summer	7	36	1	4	31	0
Control	Jan-03	Summer	1	49	9	18	20	2
Control	Jan-03	Summer	2	16	3	3	10	0
Control	Jan-03	Summer	3	103	17	18	49	19
Control	Jan-03	Summer	4	60	4	8	43	5
Control	Jan-03	Summer	5	0	0	0	0	0
Control	Jan-03	Summer	6	52	7	9	33	3
Control	Jan-03	Summer	7	9	2	0	6	1
Conventional	Feb-03	Summer	1	6	0	2	4	0
Conventional	Feb-03	Summer	2	17	1	3	12	1
Conventional	Feb-03	Summer	3	8	0	0	5	3
Conventional	Feb-03	Summer	4	18	2	3	13	0
Conventional	Feb-03	Summer	5	3	0	0	3	0
Conventional	Feb-03	Summer	6	21	0	13	8	0
Conventional	Feb-03	Summer	7	49	23	9	14	3
Organic	Feb-03	Summer	1	26	3	4	13	6
Organic	Feb-03	Summer	2	20	0	0	19	1
Organic	Feb-03	Summer	3	16	2	1	11	2
Organic	Feb-03	Summer	4	8	1	0	7	0
Organic	Feb-03	Summer	5	12	0	0	11	1
Organic	Feb-03	Summer	6	11	1	0	6	4
Organic	Feb-03	Summer	7	25	1	2	17	5
Control	Feb-03	Summer	1	37	3	18	13	3
Control	Feb-03	Summer	2	46	10	4	23	9
Control	Feb-03	Summer	3	46	10	3	14	19
Control	Feb-03	Summer	4	52	6	6	28	12
Control	Feb-03	Summer	5	6	0	0	5	1

Control	Feb-03	Summer	6	28	4	2	22	0
Control	Feb-03	Summer	7	3	0	0	3	0
Conventional	Mar-03	Autumn	1	45	0	9	35	1
Conventional	Mar-03	Autumn	2	26	1	2	19	4
Conventional	Mar-03	Autumn	3	47	1	15	27	4
Conventional	Mar-03	Autumn	4	2	0	0	2	0
Conventional	Mar-03	Autumn	5	42	2	15	22	3
Conventional	Mar-03	Autumn	6	11	0	1	7	3
Conventional	Mar-03	Autumn	7	29	1	5	22	1
Organic	Mar-03	Autumn	1	33	2	0	28	3
Organic	Mar-03	Autumn	2	27	3	5	17	2
Organic	Mar-03	Autumn	3	19	2	3	10	4
Organic	Mar-03	Autumn	4	52	0	2	43	7
Organic	Mar-03	Autumn	5	19	2	0	17	0
Organic	Mar-03	Autumn	6	34	2	0	31	1
Organic	Mar-03	Autumn	7	47	2	3	40	2
Control	Mar-03	Autumn	1	19	1	1	16	1
Control	Mar-03	Autumn	2	82	5	8	54	15
Control	Mar-03	Autumn	3	103	7	8	49	39
Control	Mar-03	Autumn	4	47	8	2	34	3
Control	Mar-03	Autumn	5	5	0	1	4	0
Control	Mar-03	Autumn	6	66	0	8	39	19
Control	Mar-03	Autumn	7	18	3	3	11	1
Conventional	Apr-03	Autumn	1	118	4	3	37	74
Conventional	Apr-03	Autumn	2	40	0	2	38	0
Conventional	Apr-03	Autumn	3	19	0	1	12	6
Conventional	Apr-03	Autumn	4	14	0	1	12	1
Conventional	Apr-03	Autumn	5	39	2	10	25	2
Conventional	Apr-03	Autumn	6	29	1	0	27	1
Conventional	Apr-03	Autumn	7	29	0	0	27	2
Organic	Apr-03	Autumn	1	42	2	5	34	1
Organic	Apr-03	Autumn	2	35	1	18	14	2
Organic	Apr-03	Autumn	3	64	1	10	47	6
Organic	Apr-03	Autumn	4	79	39	11	26	3
Organic	Apr-03	Autumn	5	47	9	8	25	5
Organic	Apr-03	Autumn	6	36	0	14	19	3
Organic	Apr-03	Autumn	7	69	4	45	17	3
Control	Apr-03	Autumn	1	35	0	2	31	2
Control	Apr-03	Autumn	2	54	2	2	46	4
Control	Apr-03	Autumn	3	70	9	22	37	2
Control	Apr-03	Autumn	4	112	21	6	69	16
Control	Apr-03	Autumn	5	81	3	11	49	18
Control	Apr-03	Autumn	6	19	2	1	15	1
Control	Apr-03	Autumn	7	38	0	6	29	3
Conventional	May-03	Autumn	1	24	1	7	13	3
Conventional	May-03	Autumn	2	25	0	4	21	0
Conventional	May-03	Autumn	3	18	0	9	9	0
Conventional	May-03	Autumn	4	252	9	85	145	13

Conventional	May-03	Autumn	5	74	6	25	38	5
Conventional	May-03	Autumn	6	98	32	19	45	2
Conventional	May-03	Autumn	7	21	1	7	12	1
Organic	May-03	Autumn	1	53	3	31	19	0
Organic	May-03	Autumn	2	63	7	31	22	3
Organic	May-03	Autumn	3	90	6	45	33	6
Organic	May-03	Autumn	4	7	0	6	1	0
Organic	May-03	Autumn	5	35	1	9	25	0
Organic	May-03	Autumn	6	22	2	10	10	0
Organic	May-03	Autumn	7	23	2	8	12	1
Control	May-03	Autumn	1	20	1	2	13	4
Control	May-03	Autumn	2	48	13	10	22	3
Control	May-03	Autumn	3	18	2	3	11	2
Control	May-03	Autumn	4	28	0	1	24	3
Control	May-03	Autumn	5	29	0	0	21	8
Control	May-03	Autumn	6	24	0	0	18	6
Control	May-03	Autumn	7	22	0	1	16	5
Conventional	Jun-03	Winter	1	32	4	16	6	6
Conventional	Jun-03	Winter	2	36	2	18	13	3
Conventional	Jun-03	Winter	3	48	5	25	16	2
Conventional	Jun-03	Winter	4	115	16	85	14	0
Conventional	Jun-03	Winter	5	62	12	37	13	0
Conventional	Jun-03	Winter	6	64	14	26	21	3
Conventional	Jun-03	Winter	7	31	9	4	18	0
Organic	Jun-03	Winter	1	86	13	52	18	3
Organic	Jun-03	Winter	2	56	11	19	24	2
Organic	Jun-03	Winter	3	73	3	23	47	0
Organic	Jun-03	Winter	4	46	6	16	21	3
Organic	Jun-03	Winter	5	86	36	18	29	3
Organic	Jun-03	Winter	6	86	21	26	38	1
Organic	Jun-03	Winter	7	72	13	28	27	4
Control	Jun-03	Winter	1	32	4	4	22	2
Control	Jun-03	Winter	2	23	5	0	18	0
Control	Jun-03	Winter	3	11	2	0	9	0
Control	Jun-03	Winter	4	34	7	4	21	2
Control	Jun-03	Winter	5	29	2	1	26	0
Control	Jun-03	Winter	6	21	0	1	18	2
Control	Jun-03	Winter	7	16	0	0	12	4
			Total	9384	2530	2499	3713	642

Table 2: Raw data for earthworm samples at Plaisir de Merle from Jun 2002 to Jun 2003

Date	Season	Treatment	Replicte	Worm mass	# worms	Adults	juveniles	Ant. Sections	*A. caligonosa*	*E. rosea*
24-Jun-02	Winter	Conventional	1	0,0148	1		1			1
24-Jun-02	Winter	Conventional	2	0,1563	1		1		1	
24-Jun-02	Winter	Conventional	3	0,0691	1			1	1	
24-Jun-02	Winter	Conventional	3	0,0758	1		1		1	
24-Jun-02	Winter	Conventional	4	0,7569	1	1			1	
24-Jun-02	Winter	Conventional	4	0,4778	1	1			1	
24-Jun-02	Winter	Conventional	4	0,1356	1		1		1	
24-Jun-02	Winter	Conventional	4	0,2121	1	1			1	
24-Jun-02	Winter	Conventional	4	0,1438	1		1		1	
24-Jun-02	Winter	Conventional	4	0,1025	1		1		1	
24-Jun-02	Winter	Conventional	4	0,0961	1		1		1	
24-Jun-02	Winter	Conventional	4	0,1633	1		1		1	
24-Jun-02	Winter	Conventional	5	0,1191	1		1			1
24-Jun-02	Winter	Conventional	5	0,4805	1	1			1	
24-Jun-02	Winter	Conventional	5	0,2140	1		1		1	
24-Jun-02	Winter	Organic	1	0	0					
24-Jun-02	Winter	Organic	2	0,0688	1		1		1	
24-Jun-02	Winter	Organic	2	0,0422	1		1		1	
24-Jun-02	Winter	Organic	2	0,1228	1		1		1	
24-Jun-02	Winter	Organic	2	0,0898	1		1			1
24-Jun-02	Winter	Organic	2	0,1913	1		1			1
24-Jun-02	Winter	Organic	2	0,1299	1		1			1
24-Jun-02	Winter	Organic	2	0,1405	1		1		1	
24-Jun-02	Winter	Organic	2	0,1729	1		1		1	
24-Jun-02	Winter	Organic	2	0,1591	1		1		1	
24-Jun-02	Winter	Organic	2	0,1485	1		1		1	
24-Jun-02	Winter	Organic	2	0,1369	1		1			1
24-Jun-02	Winter	Organic	2	0,2878	1		1			1
24-Jun-02	Winter	Organic	2	0,4486	1	1			1	
24-Jun-02	Winter	Organic	2	0,5328	1	1			1	

Date	Season	Treatment	Replicte	Worm mass	# worms	Adults	juveniles	Ant. Sections	*A. caligonosa*	*E. rosea*
24-Jun-02	Winter	Organic	2	0,5517	1	1			1	
24-Jun-02	Winter	Organic	3	0,0400	1		1			1
24-Jun-02	Winter	Organic	3	0,0142	1		1			1
24-Jun-02	Winter	Organic	3	0,1242	1		1			1
24-Jun-02	Winter	Organic	3	0,0538	1		1			1
24-Jun-02	Winter	Organic	3	0,0287	1		1			1
24-Jun-02	Winter	Organic	3	0,1513	1		1		1	
24-Jun-02	Winter	Organic	3	0,1592	1		1		1	
24-Jun-02	Winter	Organic	3	0,1080	1		1		1	
24-Jun-02	Winter	Organic	3	0,1007	1		1		1	
24-Jun-02	Winter	Organic	3	0,0836	1		1		1	
24-Jun-02	Winter	Organic	3	0,2411	1		1		1	
24-Jun-02	Winter	Organic	3	0,1052	1		1		1	
24-Jun-02	Winter	Organic	3	0,3043	1	1				1
24-Jun-02	Winter	Organic	3	0,0934	1		1		1	
24-Jun-02	Winter	Organic	3	0,2723	1		1		1	
24-Jun-02	Winter	Organic	3	0,3476	1	1			1	
24-Jun-02	Winter	Organic	3	0,1791	1		1		1	
24-Jun-02	Winter	Organic	3	0,7605	1	1			1	
24-Jun-02	Winter	Organic	3	0,5359	1	1			1	
24-Jun-02	Winter	Organic	3	0,1929	1		1			1
24-Jun-02	Winter	Organic	3	0,5257	1	1			1	
24-Jun-02	Winter	Organic	3	0,3223	1	1			1	
24-Jun-02	Winter	Organic	3	0,4067	1	1			1	
24-Jun-02	Winter	Organic	3	0,7677	1	1			1	
24-Jun-02	Winter	Organic	4	0,0359	1		1		1	
24-Jun-02	Winter	Organic	4	0,0092	1		1			1
24-Jun-02	Winter	Organic	4	0,0328	1		1			1
24-Jun-02	Winter	Organic	4	0,0868	1		1			1
24-Jun-02	Winter	Organic	4	0,1445	1		1			1
24-Jun-02	Winter	Organic	4	0,1970	1		1			1

Date	Season	Treatment	Replicte	Worm mass	# worms	Adults	juveniles	Ant. Sections	*A. caligonosa*	*E. rosea*
24-Jun-02	Winter	Organic	4	0,2204	1		1		1	
24-Jun-02	Winter	Organic	4	0,1696	1		1		1	
24-Jun-02	Winter	Organic	4	0,2738	1		1		1	
24-Jun-02	Winter	Organic	4	0,2479	1		1		1	
24-Jun-02	Winter	Organic	4	0,4936	1	1			1	
24-Jun-02	Winter	Organic	4	0,4803	1	1			1	
24-Jun-02	Winter	Organic	5	0,1188	1		1		1	
24-Jun-02	Winter	Organic	5	0,2369	1	1			1	
24-Jun-02	Winter	Organic	5	0,2982	1	1			1	
24-Jun-02	Winter	Organic	5	0,1526	1		1		1	
24-Jun-02	Winter	Organic	5	0,1811	1		1		1	
24-Jun-02	Winter	Organic	5	0,2040	1		1		1	
24-Jun-02	Winter	Organic	5	0,1701	1		1		1	
24-Jun-02	Winter	Organic	5	0,3082	1	1				1
24-Jun-02	Winter	Organic	5	0,2637	1		1		1	
24-Jun-02	Winter	Organic	5	0,0842	1		1		1	
24-Jun-02	Winter	Organic	5	0,1570	1		1		1	
24-Jun-02	Winter	Organic	5	0,0181	1		1		1	
24-Jun-02	Winter	Organic	5	0,5180	1	1			1	
24-Jun-02	Winter	Organic	5	0,2304	1		1		1	
24-Jun-02	Winter	Organic	5	0,3364	1	1			1	
24-Jun-02	Winter	Organic	5	0,3140	1		1		1	
24-Jun-02	Winter	Organic	5	0,1893	1		1			1
24-Jun-02	Winter	Organic	5	0,1759	1		1			1
24-Jun-02	Winter	Organic	5	0,4291	1	1				1
24-Jun-02	Winter	Control	1	0,0755	1		1			
24-Jun-02	Winter	Control	1	0,0531	1		1			
24-Jun-02	Winter	Control	1	0,0608	1		1			
24-Jun-02	Winter	Control	1	0,0641	1		1			
24-Jun-02	Winter	Control	1	0,1016	1		1			
24-Jun-02	Winter	Control	1	0,0500	1		1			

Date	Season	Treatment	Replicte	Worm mass	# worms	Adults	juveniles	Ant. Sections	*A. caligonosa*	*E. rosea*
24-Jun-02	Winter	Control	1	0,0326	1		1			
24-Jun-02	Winter	Control	1	0,0818	1		1			
24-Jun-02	Winter	Control	1	0,0857	1		1			
24-Jun-02	Winter	Control	1	0,1524	1		1			
24-Jun-02	Winter	Control	1	0,1261	1		1			
24-Jun-02	Winter	Control	1	0,1774	1		1			
24-Jun-02	Winter	Control	1	0,2215	1		1			
24-Jun-02	Winter	Control	1	0,2430	1	1				
24-Jun-02	Winter	Control	1	0,2237	1	1				
24-Jun-02	Winter	Control	1	0,2343	1	1				
24-Jun-02	Winter	Control	2	0,0442	1		1			
24-Jun-02	Winter	Control	2	0,0041	1		1			
24-Jun-02	Winter	Control	2	0,1384	1		1			
24-Jun-02	Winter	Control	2	0,0916	1		1			
24-Jun-02	Winter	Control	2	0,2308	1	1				
24-Jun-02	Winter	Control	2	0,1119	1		1			
24-Jun-02	Winter	Control	2	0,1576	1		1			
24-Jun-02	Winter	Control	2	0,1649	1		1			
24-Jun-02	Winter	Control	2	0,0711	1		1			
24-Jun-02	Winter	Control	2	0,0191	1		1			
24-Jun-02	Winter	Control	2	0,0693	1		1			
24-Jun-02	Winter	Control	2	0,0834	1		1			
24-Jun-02	Winter	Control	2	0,1368	1		1			
24-Jun-02	Winter	Control	2	0,5361	1	1				
24-Jun-02	Winter	Control	2	0,0503	1		1			
24-Jun-02	Winter	Control	2	0,0631	1		1			
24-Jun-02	Winter	Control	2	0,0495	1		1			
24-Jun-02	Winter	Control	2	0,0673	1		1			
24-Jun-02	Winter	Control	2	0,0489	1		1			
24-Jun-02	Winter	Control	2	0,0870	1		1			
24-Jun-02	Winter	Control	2	0,1018	1		1			

Date	Season	Treatment	Replicte	Worm mass	# worms	Adults	juveniles	Ant. Sections	*A. caligonosa*	*E. rosea*
24-Jun-02	Winter	Control	2	0,2330	1		1			
24-Jun-02	Winter	Control	2	0,0917	1		1			
24-Jun-02	Winter	Control	2	0,0992	1		1			
24-Jun-02	Winter	Control	2	0,0561	1		1			
24-Jun-02	Winter	Control	2	0,0887	1		1			
24-Jun-02	Winter	Control	2	0,0694	1		1			
24-Jun-02	Winter	Control	2	0,0934	1		1			
24-Jun-02	Winter	Control	2	0,0889	1		1			
24-Jun-02	Winter	Control	2	0,3531	1	1				
24-Jun-02	Winter	Control	2	0,1222	1		1			
24-Jun-02	Winter	Control	2	0,1188	1		1			
24-Jun-02	Winter	Control	2	0,0919	1		1			
24-Jun-02	Winter	Control	2	0,0526	1		1			
24-Jun-02	Winter	Control	2	0,0487	1		1			
24-Jun-02	Winter	Control	2	0,1341	1		1			
24-Jun-02	Winter	Control	2	0,1106	1		1			
24-Jun-02	Winter	Control	2	0,0475	1		1			
24-Jun-02	Winter	Control	2	0,1148	1		1			
24-Jun-02	Winter	Control	2	0,0938	1		1			
24-Jun-02	Winter	Control	2	0,0116	1		1			
24-Jun-02	Winter	Control	2	0,0862	1		1			
24-Jun-02	Winter	Control	2	0,2863	1		1			
24-Jun-02	Winter	Control	2	0,1764	1		1			
24-Jun-02	Winter	Control	2	0,0998	1		1			
24-Jun-02	Winter	Control	2	0,0714	1		1			
24-Jun-02	Winter	Control	2	0,0291	1		1			
24-Jun-02	Winter	Control	3	0,1030	1		1			
24-Jun-02	Winter	Control	3	0,1615	1		1			
24-Jun-02	Winter	Control	3	0,0400	1		1			
24-Jun-02	Winter	Control	3	0,0377	1		1			
24-Jun-02	Winter	Control	4	0,8531	1	1				

Date	**Season**	**Treatment**	**Replicte**	**Worm mass**	**# worms**	**Adults**	**juveniles**	**Ant. Sections**	***A. caligonosa***	***E. rosea***
24-Jun-02	Winter	Control	4	0,3137	1		1			
24-Jun-02	Winter	Control	4	1,1899	1	1				
24-Jun-02	Winter	Control	4	1,0794	1	1				
24-Jun-02	Winter	Control	4	0,8253	1	1				
24-Jun-02	Winter	Control	5	0,0382	1		1			
24-Jun-02	Winter	Control	5	0,0964	1		1			
24-Jun-02	Winter	Control	5	0,5339	1	1				
24-Jul-02	Winter	Conventional	1	0,0613	1			1		
24-Jul-02	Winter	Conventional	2	0	0					
24-Jul-02	Winter	Conventional	3	0	0					
24-Jul-02	Winter	Conventional	4	0,2595	1	1				
24-Jul-02	Winter	Conventional	4	0,4973	1	1				
24-Jul-02	Winter	Conventional	5	0,1409	1		1			
24-Jul-02	Winter	Conventional	5	0,0704	1		1			
24-Jul-02	Winter	Conventional	5	0,1313	1		1			
24-Jul-02	Winter	Conventional	5	0,1859	1		1			
24-Jul-02	Winter	Conventional	5	0,1986	1		1			
24-Jul-02	Winter	Conventional	5	0,0625	1			1		
24-Jul-02	Winter	Organic	1	0,1949	1		1			
24-Jul-02	Winter	Organic	1	0,175	1		1			
24-Jul-02	Winter	Organic	1	0,5799	1	1				
24-Jul-02	Winter	Organic	1	0,3822	1	1				
24-Jul-02	Winter	Organic	1	0,6284	1	1				
24-Jul-02	Winter	Organic	2	0,3535	1	1				
24-Jul-02	Winter	Organic	2	0,1071	1		1			
24-Jul-02	Winter	Organic	2	0,0955	1			1		
24-Jul-02	Winter	Organic	2	0,5423	1	1				
24-Jul-02	Winter	Organic	2	0,1103	1		1			
24-Jul-02	Winter	Organic	2	0,3804	1	1				
24-Jul-02	Winter	Organic	2	0,1147	1		1			
24-Jul-02	Winter	Organic	2	0,284	1		1			

Date	Season	Treatment	Replicte	Worm mass	# worms	Adults	juveniles	Ant. Sections	*A. caligonosa*	*E. rosea*
24-Jul-02	Winter	Organic	2	0,1385	1		1			
24-Jul-02	Winter	Organic	2	0,1271	1		1			
24-Jul-02	Winter	Organic	2	0,4742	1	1				
24-Jul-02	Winter	Organic	3	0,0393	1			1		
24-Jul-02	Winter	Organic	3	0,02	1		1			
24-Jul-02	Winter	Organic	3	0,1833	1		1			
24-Jul-02	Winter	Organic	3	0,0754	1		1			
24-Jul-02	Winter	Organic	3	0,057	1		1			
24-Jul-02	Winter	Organic	3	0,3361	1	1				
24-Jul-02	Winter	Organic	3	0,5637	1	1				
24-Jul-02	Winter	Organic	3	0,21	1		1			
24-Jul-02	Winter	Organic	3	0,4633	1	1				
24-Jul-02	Winter	Organic	3	0,1739	1		1			
24-Jul-02	Winter	Organic	3	0,109	1		1			
24-Jul-02	Winter	Organic	3	0,2292	1	1				
24-Jul-02	Winter	Organic	4	0,0898	1		1			
24-Jul-02	Winter	Organic	4	0,2208	1		1			
24-Jul-02	Winter	Organic	4	0,2344	1		1			
24-Jul-02	Winter	Organic	4	0,3042	1		1			
24-Jul-02	Winter	Organic	4	0,9553	1	1				
24-Jul-02	Winter	Organic	4	0,9323	1	1				
24-Jul-02	Winter	Organic	5	0,1553	1		1			
24-Jul-02	Winter	Organic	5	0,1192	1		1			
24-Jul-02	Winter	Organic	5	0,1077	1		1			
24-Jul-02	Winter	Organic	5	0,3372	1	1				
24-Jul-02	Winter	Organic	5	0,2109	1		1			
24-Jul-02	Winter	Organic	5	0,188	1		1			
24-Jul-02	Winter	Organic	5	0,2838	1	1				
24-Jul-02	Winter	Organic	5	0,4158	1	1				
24-Jul-02	Winter	Organic	5	0,3298	1	1				
24-Jul-02	Winter	Control	1	0,119	1		1			

Date	**Season**	**Treatment**	**Replicte**	**Worm mass**	**# worms**	**Adults**	**juveniles**	**Ant. Sections**	***A. caligonosa***	***E. rosea***
24-Jul-02	Winter	Control	1	0,5551	1	1				
24-Jul-02	Winter	Control	1	0,469	1	1				
24-Jul-02	Winter	Control	1	0,3021	1		1			
24-Jul-02	Winter	Control	1	0,7022	1	1				
24-Jul-02	Winter	Control	1	0,8969	1	1				
24-Jul-02	Winter	Control	1	0,5836	1	1				
24-Jul-02	Winter	Control	1	0,0732	1		1			
24-Jul-02	Winter	Control	2	0,3354	1		1			
24-Jul-02	Winter	Control	2	0,2076	1			1		
24-Jul-02	Winter	Control	2	0,7939	1	1				
24-Jul-02	Winter	Control	2	0,5729	1	1				
24-Jul-02	Winter	Control	2	0,6363	1	1				
24-Jul-02	Winter	Control	2	0,8709	1	1				
24-Jul-02	Winter	Control	3	0,659	1	1				
24-Jul-02	Winter	Control	3	0,6049	1	1				
24-Jul-02	Winter	Control	3	0,7512	1	1				
24-Jul-02	Winter	Control	4	0,198	1		1			
24-Jul-02	Winter	Control	4	0,3487	1		1			
24-Jul-02	Winter	Control	5	0,1205	1			1		
24-Jul-02	Winter	Control	5	0,1644	1		1			
24-Jul-02	Winter	Control	5	0,8522	1	1				
10-Sep-02	Spring	Conventional	1	0,1151	1	1		1	1	
10-Sep-02	Spring	Conventional	2	0,6584	1	1			1	
10-Sep-02	Spring	Conventional	2	0,058	1		1			1
10-Sep-02	Spring	Conventional	2	0,0961	1		1		1	
10-Sep-02	Spring	Conventional	2	0,3273	1		1		1	
10-Sep-02	Spring	Conventional	2	0,1432	1			1	1	
10-Sep-02	Spring	Conventional	3	0	0					
10-Sep-02	Spring	Conventional	4	0,1868	1			1	1	
10-Sep-02	Spring	Conventional	5	0	0					
10-Sep-02	Spring	Organic	1	0	0					

Date	Season	Treatment	Replicte	Worm mass	# worms	Adults	juveniles	Ant. Sections	*A. caligonosa*	*E. rosea*
10-Sep-02	Spring	Organic	2	0,1922	1			1	1	
10-Sep-02	Spring	Organic	3	0	0					
10-Sep-02	Spring	Organic	4	0	0					
10-Sep-02	Spring	Organic	5	0	0					
10-Sep-02	Spring	Control	1	0,4397	1	1			1	
10-Sep-02	Spring	Control	1	0,3755	1	1			1	
10-Sep-02	Spring	Control	1	0,205	1		1			1
10-Sep-02	Spring	Control	1	0,1405	1				1	
10-Sep-02	Spring	Control	1	0,0747	1	1				1
10-Sep-02	Spring	Control	1	0,0664	1		1		1	
10-Sep-02	Spring	Control	1	0,1749	1		1		1	
10-Sep-02	Spring	Control	1	0,05	1				1	
10-Sep-02	Spring	Control	1	0,0815	1			1	1	
10-Sep-02	Spring	Control	2	0,7929	1	1			1	
10-Sep-02	Spring	Control	2	0,5262	1	1			1	
10-Sep-02	Spring	Control	2	0,242	1		1		1	
10-Sep-02	Spring	Control	2	0,2926	1		1		1	
10-Sep-02	Spring	Control	2	0,1938	1		1		1	
10-Sep-02	Spring	Control	2	0,1264	1		1		1	
10-Sep-02	Spring	Control	2	0,146	1		1		1	
10-Sep-02	Spring	Control	2	0,1121	1		1		1	
10-Sep-02	Spring	Control	2	0,119	1		1		1	
10-Sep-02	Spring	Control	2	0,0424	1		1		1	
10-Sep-02	Spring	Control	2	0,0366	1		1		1	
10-Sep-02	Spring	Control	2	0,0493	1		1		1	
10-Sep-02	Spring	Control	2	0,0989	1		1		1	
10-Sep-02	Spring	Control	3	0,0945	1		1			1
10-Sep-02	Spring	Control	3	0,0615	1		1			1
10-Sep-02	Spring	Control	3	0,1531	1		1			1
10-Sep-02	Spring	Control	3	0,0731	1			1		1
10-Sep-02	Spring	Control	3	0,1061	1		1			1

Date	Season	Treatment	Replicte	Worm mass	# worms	Adults	juveniles	Ant. Sections	*A. caligonosa*	*E. rosea*
10-Sep-02	Spring	Control	3	0,1144	1		1		1	
10-Sep-02	Spring	Control	3	0,0837	1			1	1	
10-Sep-02	Spring	Control	3	0,4562	1	1			1	
10-Sep-02	Spring	Control	3	0,5225	1	1			1	
10-Sep-02	Spring	Control	3	0,4801	1	1			1	
10-Sep-02	Spring	Control	3	0,6299	1	1			1	
10-Sep-02	Spring	Control	3	0,3781	1		1		1	
10-Sep-02	Spring	Control	3	0,2662	1		1		1	
10-Sep-02	Spring	Control	3	0,0764	1		1		1	
10-Sep-02	Spring	Control	3	0,2079	1		1		1	
10-Sep-02	Spring	Control	4	0,0393	1		1		1	
10-Sep-02	Spring	Control	4	0,077	1		1		1	
10-Sep-02	Spring	Control	4	0,0527	1		1		1	
10-Sep-02	Spring	Control	4	0,1108	1		1		1	
10-Sep-02	Spring	Control	4	0,1095	1		1		1	
10-Sep-02	Spring	Control	4	0,0975	1		1		1	
10-Sep-02	Spring	Control	4	0,2953	1		1		1	
10-Sep-02	Spring	Control	4	0,1417	1		1		1	
10-Sep-02	Spring	Control	4	0,3342	1		1		1	
10-Sep-02	Spring	Control	4	0,1142	1		1		1	
10-Sep-02	Spring	Control	4	0,1132	1		1		1	
10-Sep-02	Spring	Control	4	0,2569	1		1		1	
10-Sep-02	Spring	Control	4	0,4019	1	1			1	
10-Sep-02	Spring	Control	4	0,4703	1	1			1	
10-Sep-02	Spring	Control	4	0,0776	1			1	1	
10-Sep-02	Spring	Control	5	0,3093	1		1		1	
10-Sep-02	Spring	Control	5	0,1127	1		1			1
10-Sep-02	Spring	Control	5	0,1731	1		1			1
10-Sep-02	Spring	Control	5	0,122	1		1			1
10-Sep-02	Spring	Control	5	0,1591	1		1		1	
10-Sep-02	Spring	Control	5	0,0691	1		1			1

Date	Season	Treatment	Replicte	Worm mass	# worms	Adults	juveniles	Ant. Sections	*A. caligonosa*	*E. rosea*
10-Sep-02	Spring	Control	5	0,5734	1	1			1	
22-Oct-02	Spring	Conventional	1	0	0					
22-Oct-02	Spring	Conventional	2	0	0					
22-Oct-02	Spring	Conventional	3	0	0					
22-Oct-02	Spring	Conventional	4	0	0					
22-Oct-02	Spring	Conventional	5	0	0					
22-Oct-02	Spring	Organic	1	0,1843	1	1				1
22-Oct-02	Spring	Organic	2	0	0					
22-Oct-02	Spring	Organic	3	0,1087	1		1			1
22-Oct-02	Spring	Organic	3	0,1372	1	1			1	
22-Oct-02	Spring	Organic	3	0,1496	1	1				1
22-Oct-02	Spring	Organic	3	0,1419	1	1			1	
22-Oct-02	Spring	Organic	3	0,4172	1	1			1	
22-Oct-02	Spring	Organic	3	0,6309	1	1			1	
22-Oct-02	Spring	Organic	4	0	0					
22-Oct-02	Spring	Organic	5	0	0					
22-Oct-02	Spring	Control	1	0,0611	1	1				1
22-Oct-02	Spring	Control	1	0,2612	1		1		1	
22-Oct-02	Spring	Control	1	0,5147	1	1			1	
22-Oct-02	Spring	Control	2	0,4022	1	1			1	
22-Oct-02	Spring	Control	2	0,249	1	1			1	
22-Oct-02	Spring	Control	3	0	0					
22-Oct-02	Spring	Control	4	0,2195	1		1		1	
22-Oct-02	Spring	Control	4	0,0618	1		1		1	
22-Oct-02	Spring	Control	4	0,2758	1	1			1	
22-Oct-02	Spring	Control	4	0,2923	1	1			1	
22-Oct-02	Spring	Control	5	0,0425	1		1			1
22-Oct-02	Spring	Control	5	0,068	1		1			1
22-Oct-02	Spring	Control	5	0,0488	1		1			1
22-Oct-02	Spring	Control	5	0,2287	1		1		1	
22-Oct-02	Spring	Control	5	0,2048	1		1		1	

Date	Season	Treatment	Replicte	Worm mass	# worms	Adults	juveniles	Ant. Sections	*A. caligonosa*	*E. rosea*
22-Oct-02	Spring	Control	5	0,2325	1		1		1	
22-Oct-02	Spring	Control	5	0,4223	1	1			1	
3-Dec-02	Summer	Conventional	1	0	0					
3-Dec-02	Summer	Conventional	2	0	0					
3-Dec-02	Summer	Conventional	3	0	0					
3-Dec-02	Summer	Conventional	4	0	0					
3-Dec-02	Summer	Conventional	5	0	0					
3-Dec-02	Summer	Organic	1	0	0					
3-Dec-02	Summer	Organic	2	0,0324	1		1		1	
3-Dec-02	Summer	Organic	2	0,3844	1	1		1	1	
3-Dec-02	Summer	Organic	2	0,2745	1		1		1	
3-Dec-02	Summer	Organic	3	0	0					
3-Dec-02	Summer	Organic	4	0,2284	1		1		1	
3-Dec-02	Summer	Organic	4	0,1664	1		1		1	
3-Dec-02	Summer	Organic	4	0,3239	1		1		1	
3-Dec-02	Summer	Organic	5	0	0					
3-Dec-02	Summer	Control	1	0,0284	1		1		1	
3-Dec-02	Summer	Control	1	0,0822	1		1		1	
3-Dec-02	Summer	Control	1	0,0934	1		1		1	
3-Dec-02	Summer	Control	1	0,2454	1		1		1	
3-Dec-02	Summer	Control	1	0,3041	1		1		1	
3-Dec-02	Summer	Control	2	0,0425	1		1		1	
3-Dec-02	Summer	Control	2	0,1067	1		1		1	
3-Dec-02	Summer	Control	2	0,2268	1		1		1	
3-Dec-02	Summer	Control	2	0,1201	1		1		1	
3-Dec-02	Summer	Control	2	0,1251	1		1		1	
3-Dec-02	Summer	Control	2	0,1149	1		1		1	
3-Dec-02	Summer	Control	3	0,0985	1		1		1	
3-Dec-02	Summer	Control	3	0,0899	1		1		1	
3-Dec-02	Summer	Control	4	0,1068	1		1		1	
3-Dec-02	Summer	Control	4	0,0912	1		1		1	

Date	**Season**	**Treatment**	**Replicte**	**Worm mass**	**# worms**	**Adults**	**juveniles**	**Ant. Sections**	***A. caligonosa***	***E. rosea***
3-Dec-02	Summer	Control	4	0,0616	1		1		1	
3-Dec-02	Summer	Control	4	0,1743	1		1		1	
3-Dec-02	Summer	Control	4	0,2129	1		1		1	
3-Dec-02	Summer	Control	4	0,3434	1	1			1	
3-Dec-02	Summer	Control	5	0,2151	1		1		1	
3-Dec-02	Summer	Control	5	0,1118	1		1		1	
20-Jan-03	Summer	Conventional	1	0	0					
20-Jan-03	Summer	Conventional	2	0	0					
20-Jan-03	Summer	Conventional	3	0	0					
20-Jan-03	Summer	Conventional	4	0	0					
20-Jan-03	Summer	Conventional	5	0	0					
20-Jan-03	Summer	Organic	1	0	0					
20-Jan-03	Summer	Organic	2	0	0					
20-Jan-03	Summer	Organic	3	0	0					
20-Jan-03	Summer	Organic	4	0	0					
20-Jan-03	Summer	Organic	5	0	0					
20-Jan-03	Summer	Control	1	0	0					
20-Jan-03	Summer	Control	2	0	0					
20-Jan-03	Summer	Control	3	0	0					
20-Jan-03	Summer	Control	4	0	0					
20-Jan-03	Summer	Control	5	0	0					
4-Mar-03	Autumn	Conventional	1	0,0753	1		1		1	
4-Mar-03	Autumn	Conventional	1	0,1099	1		1		1	
4-Mar-03	Autumn	Conventional	1	0,1472	1		1		1	
4-Mar-03	Autumn	Conventional	1	0,2045	1		1		1	
4-Mar-03	Autumn	Conventional	1	0,3576	1	1			1	
4-Mar-03	Autumn	Conventional	2	0,1963	1		1		1	
4-Mar-03	Autumn	Conventional	2	0,3054	1	1			1	
4-Mar-03	Autumn	Conventional	3	0	0					
4-Mar-03	Autumn	Conventional	4	0	0					
4-Mar-03	Autumn	Conventional	5	0	0					

Date	Season	Treatment	Replicte	Worm mass	# worms	Adults	juveniles	Ant. Sections	*A. caligonosa*	*E. rosea*
4-Mar-03	Autumn	Organic	1	0,2958	1		1		1	
4-Mar-03	Autumn	Organic	1	0,4229	1	1			1	
4-Mar-03	Autumn	Organic	2	0,0782	1		1		1	
4-Mar-03	Autumn	Organic	2	0,1349	1		1		1	
4-Mar-03	Autumn	Organic	2	0,2473	1		1		1	
4-Mar-03	Autumn	Organic	2	0,3192	1		1		1	
4-Mar-03	Autumn	Organic	2	0,464	1	1			1	
4-Mar-03	Autumn	Organic	2	0,3469	1	1			1	
4-Mar-03	Autumn	Organic	3	0,262	1		1		1	
4-Mar-03	Autumn	Organic	4	0,3733	1		1		1	
4-Mar-03	Autumn	Organic	5	0,1991	1			1	1	
4-Mar-03	Autumn	Organic	5	0,4695	1	1			1	
4-Mar-03	Autumn	Control	1	0,1423	1		1		1	
4-Mar-03	Autumn	Control	1	0,2305	1		1		1	
4-Mar-03	Autumn	Control	1	0,2549	1		1		1	
4-Mar-03	Autumn	Control	1	0,1687	1		1		1	
4-Mar-03	Autumn	Control	1	0,2583	1		1		1	
4-Mar-03	Autumn	Control	1	0,2914	1		1		1	
4-Mar-03	Autumn	Control	1	0,2842	1		1		1	
4-Mar-03	Autumn	Control	1	0,3536	1	1			1	
4-Mar-03	Autumn	Control	1	0,4162	1	1			1	
4-Mar-03	Autumn	Control	2	0	1				1	
4-Mar-03	Autumn	Control	3	0,0752	1		1		1	
4-Mar-03	Autumn	Control	3	0,0877	1		1		1	
4-Mar-03	Autumn	Control	3	0,3223	1	1			1	
4-Mar-03	Autumn	Control	4	0	1				1	
4-Mar-03	Autumn	Control	5	0,133	1		1		1	
4-Mar-03	Autumn	Control	5	0,1728	1		1		1	
4-Mar-03	Autumn	Control	5	0,4071	1	1			1	
3-Apr-03	Autumn	Conventional	1	0,0382	1		1		1	
3-Apr-03	Autumn	Conventional	1	0,0964	1		1		1	

Date	Season	Treatment	Replicte	Worm mass	# worms	Adults	juveniles	Ant. Sections	*A. caligonosa*	*E. rosea*
3-Apr-03	Autumn	Conventional	1	0,5339	1	1			1	
3-Apr-03	Autumn	Conventional	2	0,0613	1		1			1
3-Apr-03	Autumn	Conventional	3	0	0					
3-Apr-03	Autumn	Conventional	4	0	0					
3-Apr-03	Autumn	Conventional	5	0,2595	1		1		1	
3-Apr-03	Autumn	Conventional	5	0,4973	1	1			1	
3-Apr-03	Autumn	Conventional	5	0,1409	1		1		1	
3-Apr-03	Autumn	Conventional	5	0,0704	1		1		1	
3-Apr-03	Autumn	Conventional	5	0,1313	1		1			1
3-Apr-03	Autumn	Conventional	5	0,1859	1		1		1	
3-Apr-03	Autumn	Organic	1	0,1986	1		1		1	
3-Apr-03	Autumn	Organic	1	0,0625	1		1		1	
3-Apr-03	Autumn	Organic	1	0,1949	1			1	1	
3-Apr-03	Autumn	Organic	1	0,175	1		1			1
3-Apr-03	Autumn	Organic	1	0,5799	1	1			1	
3-Apr-03	Autumn	Organic	1	0,3822	1	1				1
3-Apr-03	Autumn	Organic	2	0,6284	1	1			1	
3-Apr-03	Autumn	Organic	2	0,3535	1	1			1	
3-Apr-03	Autumn	Organic	2	0,1071	1			1		1
3-Apr-03	Autumn	Organic	3	0,0955	1		1			1
3-Apr-03	Autumn	Organic	3	0,5423	1	1			1	
3-Apr-03	Autumn	Organic	4	0,1103	1		1		1	
3-Apr-03	Autumn	Organic	4	0,3804	1	1			1	
3-Apr-03	Autumn	Organic	4	0,1147	1		1			1
3-Apr-03	Autumn	Organic	4	0,284	1		1			1
3-Apr-03	Autumn	Organic	4	0,1385	1		1			1
3-Apr-03	Autumn	Organic	4	0,1271	1		1			1
3-Apr-03	Autumn	Organic	4	0,4742	1	1			1	
3-Apr-03	Autumn	Organic	5	0,0393	1		1		1	
3-Apr-03	Autumn	Organic	5	0,02	1		1			1
3-Apr-03	Autumn	Organic	5	0,1833	1		1		1	

Date	Season	Treatment	Replicte	Worm mass	# worms	Adults	juveniles	Ant. Sections	*A. caligonosa*	*E. rosea*
3-Apr-03	Autumn	Organic	5	0,0754	1		1		1	
3-Apr-03	Autumn	Organic	5	0,057	1		1		1	
3-Apr-03	Autumn	Organic	5	0,3361	1	1			1	
3-Apr-03	Autumn	Organic	5	0,5637	1	1			1	
3-Apr-03	Autumn	Organic	5	0,21	1		1		1	
3-Apr-03	Autumn	Organic	5	0,4633	1	1			1	
3-Apr-03	Autumn	Control	1	0,0688	1		1		1	
3-Apr-03	Autumn	Control	1	0,0422	1		1		1	
3-Apr-03	Autumn	Control	1	0,1228	1		1		1	
3-Apr-03	Autumn	Control	1	0,0898	1		1		1	
3-Apr-03	Autumn	Control	1	0,1913	1		1		1	
3-Apr-03	Autumn	Control	1	0,1299	1		1		1	
3-Apr-03	Autumn	Control	1	0,1405	1		1			1
3-Apr-03	Autumn	Control	1	0,1729	1		1			1
3-Apr-03	Autumn	Control	2	0,1591	1		1			1
3-Apr-03	Autumn	Control	2	0,1485	1		1		1	
3-Apr-03	Autumn	Control	2	0,1369	1		1		1	
3-Apr-03	Autumn	Control	2	0,2878	1	1			1	
3-Apr-03	Autumn	Control	2	0,4486	1	1			1	
3-Apr-03	Autumn	Control	2	0,5328	1	1			1	
3-Apr-03	Autumn	Control	2	0,5517	1	1			1	
3-Apr-03	Autumn	Control	3	0,0400	1		1		1	
3-Apr-03	Autumn	Control	3	0,0142	1		1		1	
3-Apr-03	Autumn	Control	3	0,1242	1			1	1	
3-Apr-03	Autumn	Control	3	0,0538	1		1		1	
3-Apr-03	Autumn	Control	4	0,0287	1		1		1	
3-Apr-03	Autumn	Control	4	0,1513	1		1		1	
3-Apr-03	Autumn	Control	4	0,1592	1		1		1	
3-Apr-03	Autumn	Control	4	0,1080	1		1		1	
3-Apr-03	Autumn	Control	4	0,1007	1		1		1	
3-Apr-03	Autumn	Control	4	0,0836	1		1		1	

Date	Season	Treatment	Replicte	Worm mass	# worms	Adults	juveniles	Ant. Sections	*A. caligonosa*	*E. rosea*
3-Apr-03	Autumn	Control	4	0,2411	1	1			1	
3-Apr-03	Autumn	Control	4	0,1052	1		1		1	
3-Apr-03	Autumn	Control	4	0,3043	1	1			1	
3-Apr-03	Autumn	Control	4	0,0934	1			1	1	
3-Apr-03	Autumn	Control	4	0,2723	1		1		1	
3-Apr-03	Autumn	Control	4	0,3476	1	1			1	
3-Apr-03	Autumn	Control	4	0,1791	1		1		1	
3-Apr-03	Autumn	Control	4	0,7605	1	1			1	
3-Apr-03	Autumn	Control	4	0,5359	1	1			1	
3-Apr-03	Autumn	Control	5	0,1929	1		1		1	
3-Apr-03	Autumn	Control	5	0,5257	1	1			1	
3-Apr-03	Autumn	Control	5	0,3223	1	1			1	
3-Apr-03	Autumn	Control	5	0,4067	1	1			1	
3-Apr-03	Autumn	Control	5	0,7677	1	1			1	
3-Apr-03	Autumn	Control	5	0,0359	1		1		1	
3-Apr-03	Autumn	Control	5	0,0092	1		1		1	
3-Apr-03	Autumn	Control	5	0,0328	1		1		1	
3-Apr-03	Autumn	Control	5	0,0868	1		1		1	
3-Apr-03	Autumn	Control	5	0,1445	1		1		1	
3-Apr-03	Autumn	Control	5	0,1970	1		1		1	
3-Apr-03	Autumn	Control	5	0,2204	1		1		1	
3-Apr-03	Autumn	Control	5	0,1696	1		1		1	
3-Apr-03	Autumn	Control	5	0,2738	1		1		1	
3-Apr-03	Autumn	Control	5	0,2479	1		1		1	
3-Apr-03	Autumn	Control	5	0,4936	1	1			1	
3-Apr-03	Autumn	Control	5	0,4803	1	1			1	
26-Jun-03	Winter	Conventional	1	0,1103	1		1		1	
26-Jun-03	Winter	Conventional	1	0,3804	1		1		1	
26-Jun-03	Winter	Conventional	1	0,1147	1		1		1	
26-Jun-03	Winter	Conventional	2	0,284	1		1		1	
26-Jun-03	Winter	Conventional	2	0,1385	1		1		1	

Date	Season	Treatment	Replicte	Worm mass	# worms	Adults	juveniles	Ant. Sections	*A. caligonosa*	*E. rosea*
26-Jun-03	Winter	Conventional	2	0,1271	1		1		1	
26-Jun-03	Winter	Conventional	2	0,4742	1	1			1	
26-Jun-03	Winter	Conventional	2	0,0393	1			1	1	
26-Jun-03	Winter	Conventional	2	0,02	1		1		1	
26-Jun-03	Winter	Conventional	2	0,1833	1		1		1	
26-Jun-03	Winter	Conventional	3	0	0				1	
26-Jun-03	Winter	Conventional	4	0,0754	1		1		1	
26-Jun-03	Winter	Conventional	4	0,057	1		1		1	
26-Jun-03	Winter	Conventional	4	0,3361	1	1			1	
26-Jun-03	Winter	Conventional	4	0,5637	1	1			1	
26-Jun-03	Winter	Conventional	4	0,21	1		1		1	
26-Jun-03	Winter	Conventional	4	0,4633	1	1				1
26-Jun-03	Winter	Conventional	4	0,1739	1		1		1	
26-Jun-03	Winter	Conventional	4	0,109	1		1		1	
26-Jun-03	Winter	Conventional	4	0,2292	1	1			1	
26-Jun-03	Winter	Conventional	4	0,0898	1		1			1
26-Jun-03	Winter	Conventional	5	0,2208	1		1			1
26-Jun-03	Winter	Conventional	5	0,2344	1		1		1	
26-Jun-03	Winter	Conventional	5	0,3042	1		1		1	
26-Jun-03	Winter	Conventional	5	0,9553	1	1			1	
26-Jun-03	Winter	Organic	1	0,0611	1	1				1
26-Jun-03	Winter	Organic	1	0,2612	1		1		1	
26-Jun-03	Winter	Organic	1	0,5147	1	1			1	
26-Jun-03	Winter	Organic	1	0,4022	1	1			1	
26-Jun-03	Winter	Organic	1	0,249	1	1			1	
26-Jun-03	Winter	Organic	2	0	0					
26-Jun-03	Winter	Organic	3	0,2195	1		1		1	
26-Jun-03	Winter	Organic	3	0,0618	1		1		1	
26-Jun-03	Winter	Organic	3	0,2758	1	1			1	
26-Jun-03	Winter	Organic	4	0,2923	1	1			1	
26-Jun-03	Winter	Organic	4	0,0425	1		1			1

Date	Season	Treatment	Replicte	Worm mass	# worms	Adults	juveniles	Ant. Sections	*A. caligonosa*	*E. rosea*
26-Jun-03	Winter	Organic	4	0,068	1		1			1
26-Jun-03	Winter	Organic	4	0,0488	1		1			1
26-Jun-03	Winter	Organic	4	0,2287	1		1		1	
26-Jun-03	Winter	Organic	4	0,2048	1		1		1	
26-Jun-03	Winter	Organic	5	0,2325	1		1		1	
26-Jun-03	Winter	Organic	5	0,4223	1	1			1	
26-Jun-03	Winter	Control	1	0,0324	1		1		1	
26-Jun-03	Winter	Control	1	0,3844	1	1		1	1	
26-Jun-03	Winter	Control	1	0,2745	1		1		1	
26-Jun-03	Winter	Control	2	0	0					
26-Jun-03	Winter	Control	3	0,2284	1		1		1	
26-Jun-03	Winter	Control	3	0,1664	1		1		1	
26-Jun-03	Winter	Control	3	0,3239	1		1		1	
26-Jun-03	Winter	Control	4	0	0					
26-Jun-03	Winter	Control	5	0,0284	1		1		1	
26-Jun-03	Winter	Control	5	0,0822	1		1		1	
26-Jun-03	Winter	Control	5	0,0934	1		1		1	
26-Jun-03	Winter	Control	5	0,2454	1		1		1	
26-Jun-03	Winter	Control	5	0,3041	1		1		1	
26-Jun-03	Winter	Control	5	0,0425	1		1		1	
26-Jun-03	Winter	Control	5	0,1067	1		1		1	
26-Jun-03	Winter	Control	5	0,2268	1		1		1	
26-Jun-03	Winter	Control	5	0,1201	1		1		1	
26-Jun-03	Winter	Control	5	0,1251	1		1		1	
26-Jun-03	Winter	Control	5	0,1149	1		1		1	
26-Jun-03	Winter	Control	5	0,0985	1		1		1	
26-Jun-03	Winter	Control	5	0,0899	1		1		1	
26-Jun-03	Winter	Control	5	0,1068	1		1		1	
26-Jun-03	Winter	Control	5	0,0912	1		1		1	
26-Jun-03	Winter	Control	5	0,0616	1		1		1	
26-Jun-03	Winter	Control	5	0,1743	1		1		1	

Date	**Season**	**Treatment**	**Replicte**	**Worm mass**	**# worms**	**Adults**	**juveniles**	**Ant. Sections**	***A. caligonosa***	***E. rosea***
26-Jun-03	Winter	Control	5	0,2129	1		1		1	
26-Jun-03	Winter	Control	5	0,3434	1	1			1	
26-Jun-03	Winter	Control	5	0,2151	1		1		1	
26-Jun-03	Winter	Control	5	0,1118	1		1		1	

Table 3: Raw data for the feeding activity at various depths from the soil surface as measured with Bait lamina tests performed at Plaisir de Merle from 18 June 2003 until 5 September 2003.

Date	Rep.	Treatment	Depth 1	Depth 2	Depth 3	Depth 4	Depth 5	Depth 6	Depth 7	Depth 8	Depth 9	Depth 10	Depth 11	Depth 12	Depth 13	Depth 14	Depth 15	Depth 16
18-Jun-03	1	Conventional	4.29	4.29	6.43	8.57	7.14	10.00	8.57	8.57	5.71	5.71	6.43	7.14	5.00	5.71	5.71	5.00
18-Jun-03	2	Conventional	8.57	9.29	8.57	8.57	8.57	7.14	7.86	9.29	7.14	7.14	8.57	7.86	6.43	6.43	5.71	6.43
18-Jun-03	1	Organic	6.43	5.00	5.00	4.29	5.71	5.71	5.00	4.29	4.29	5.71	7.14	5.00	3.57	4.29	2.86	5.00
18-Jun-03	2	Organic	5.00	5.00	4.29	5.71	6.43	6.43	7.14	5.71	7.14	5.00	4.29	4.29	3.57	5.00	5.00	5.71
18-Jun-03	1	Control	0.71	0.71	2.86	1.43	2.14	0.71	1.43	2.86	2.86	2.14	1.43	2.14	1.43	2.14	0.71	1.43
18-Jun-03	2	Control	2.86	5.00	5.00	5.00	6.43	5.00	4.29	5.71	5.00	5.00	5.00	3.57	3.57	4.29	3.57	3.57
4-Jul-03	1	Conventional	8.24	7.06	9.41	8.82	7.06	7.65	8.24	7.65	7.65	7.65	5.88	5.29	4.71	5.29	4.71	5.29
4-Jul-03	2	Conventional	6.47	5.88	5.29	4.71	6.47	5.88	5.29	3.53	5.88	5.29	4.71	4.12	4.71	3.53	2.35	2.35
4-Jul-03	3	Conventional	7.65	5.88	7.06	7.06	4.71	5.29	6.47	6.47	5.29	4.71	4.71	6.47	5.29	4.71	5.29	4.71
4-Jul-03	4	Conventional	7.65	6.47	6.47	6.47	7.06	7.06	7.06	5.88	8.24	6.47	7.06	6.47	5.88	5.88	5.88	5.88

4-Jul-03	1	Organic	5.29	4.12	5.88	5.29	5.29	5.29	5.29	5.88	5.88	6.47	6.47	5.88	5.88	5.29	5.88	6.47
4-Jul-03	2	Organic	4.12	5.88	7.65	7.65	7.65	7.06	7.06	8.24	5.29	5.88	8.24	5.29	4.71	4.71	5.88	5.29
4-Jul-03	3	Organic	5.88	8.24	9.41	8.24	8.24	9.41	7.65	8.82	7.65	5.29	4.12	4.12	4.12	4.12	4.12	2.94
4-Jul-03	4	Organic	4.12	4.12	5.29	5.29	3.53	2.94	5.88	6.47	6.47	4.71	4.12	4.71	4.12	5.88	4.71	5.88
4-Jul-03	1	Control	4.12	4.71	4.12	1.76	2.35	3.53	4.12	5.88	4.71	4.71	4.12	2.94	2.94	2.94	1.18	2.35
4-Jul-03	2	Control	4.12	5.29	5.29	3.53	4.12	4.12	4.12	5.29	3.53	4.12	1.76	2.94	2.35	4.12	2.94	1.76
4-Jul-03	3	Control	2.94	4.12	3.53	1.76	0.59	1.18	1.18	1.18	0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4-Jul-03	4	Control	0.59	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.00	0.59	0.59	0.59	0.00	1.18	0.00	0.00
21-Jul-03	1	Conventional	6.67	6.67	7.22	6.11	6.11	7.78	7.22	6.11	7.78	7.22	5.56	6.67	6.67	6.67	8.33	7.22
21-Jul-03	2	Conventional	7.22	7.22	7.78	6.67	6.11	7.22	7.78	6.11	6.11	7.22	6.67	7.78	7.78	5.56	7.22	7.22
21-Jul-03	3	Conventional	8.89	7.78	6.67	6.67	5.56	6.67	6.67	6.67	6.11	5.56	5.56	5.00	5.00	7.22	6.11	7.22
21-Jul-03	1	Organic	7.78	6.67	6.11	6.11	6.11	5.56	7.22	7.78	7.22	8.33	8.89	7.78	8.33	7.22	7.22	8.89

21-Jul-03	2	Organic	8.33	8.33	7.78	7.78	6.67	6.11	7.78	7.78	6.67	6.67	7.78	8.33	7.78	7.22	8.33	7.78
21-Jul-03	3	Organic	7.78	7.78	8.33	7.78	8.33	8.33	7.22	6.67	8.33	7.78	7.78	8.33	7.78	8.33	8.33	8.33
21-Jul-03	1	Control	6.11	5.56	7.78	7.78	7.22	7.78	8.89	8.89	7.78	7.78	8.89	8.89	7.22	8.33	7.22	6.67
21-Jul-03	2	Control	6.67	6.11	7.22	6.11	7.78	7.78	7.78	7.78	8.33	8.33	7.78	8.33	7.78	6.67	6.11	5.56
21-Jul-03	3	Control	8.33	6.67	7.22	7.22	6.67	6.11	6.11	7.22	6.11	7.22	8.33	7.22	5.56	6.11	5.00	6.11
7-Aug-03	1	Conventional	5.33	8.00	8.67	9.33	7.33	8.67	9.33	8.00	6.67	6.00	6.00	5.33	3.33	6.00	5.33	4.67
7-Aug-03	2	Conventional	8.00	9.33	8.67	8.67	9.33	9.33	7.33	8.00	6.67	8.00	8.00	8.00	6.67	7.33	6.67	6.67
7-Aug-03	3	Conventional	10.00	10.00	10.00	10.00	10.67	10.00	10.00	10.67	10.00	8.67	10.00	8.67	9.33	10.67	10.00	8.67
7-Aug-03	1	Organic	2.67	5.33	6.67	8.00	6.67	6.67	6.00	8.67	6.67	5.33	6.67	6.67	6.67	4.00	6.67	6.67
7-Aug-03	2	Organic	5.33	6.67	5.33	8.00	8.67	7.33	8.00	10.00	8.67	8.67	8.00	8.00	9.33	6.67	8.00	7.33
7-Aug-03	3	Organic	7.33	8.00	6.00	7.33	8.67	6.67	6.67	8.67	6.67	6.00	7.33	7.33	8.00	8.67	6.67	8.67
7-Aug-03	1	Control	0.00	0.00	0.00	0.00	0.67	0.67	0.00	0.00	0.67	0.67	0.00	0.67	0.67	0.00	0.00	0.67

7-Aug-03	2	Control	9.33	10.00	8.67	8.00	7.33	5.33	6.67	6.00	5.33	6.67	8.00	6.67	5.33	6.00	4.00	3.33
7-Aug-03	3	Control	0.00	0.00	0.67	0.67	0.00	0.67	0.00	0.00	0.00	1.33	0.00	0.00	0.00	1.33	0.67	0.00
21-Aug-03	1	Conventional	7.14	7.14	8.57	8.57	9.29	9.29	9.29	10.71	9.29	10.71	10.00	10.00	8.57	7.86	9.29	10.71
21-Aug-03	2	Conventional	7.86	9.29	9.29	8.57	9.29	7.86	6.43	8.57	7.14	7.86	8.57	7.14	7.86	9.29	9.29	7.86
21-Aug-03	1	Organic	7.14	8.57	9.29	10.00	8.57	7.86	8.57	7.86	7.86	10.71	10.00	10.71	9.29	8.57	9.29	7.86
21-Aug-03	2	Organic	10.00	10.00	7.86	8.57	7.14	7.86	8.57	8.57	9.29	10.71	10.00	10.00	10.71	10.00	10.00	9.29
21-Aug-03	1	Control	5.71	6.43	6.43	7.14	5.71	7.14	7.14	9.29	10.00	10.00	8.57	10.71	10.00	10.00	11.43	10.71
21-Aug-03	2	Control	9.29	9.29	9.29	9.29	8.57	7.14	4.29	6.43	7.86	10.00	8.57	6.43	5.00	7.14	9.29	7.86
5-Sep-03	1	Conventional	8.67	10.00	10.00	9.33	7.33	8.00	8.00	8.67	7.33	7.33	6.67	8.00	8.00	8.00	8.00	7.33
5-Sep-03	2	Conventional	8.67	5.33	4.00	7.33	8.67	7.33	6.67	9.33	8.67	9.33	7.33	8.00	6.00	9.33	8.67	10.67
5-Sep-03	1	Organic	8.00	8.67	8.67	8.67	8.00	8.00	8.67	8.67	8.00	8.00	8.67	8.67	8.67	8.67	8.67	8.67
5-Sep-03	2	Organic	10.00	8.67	10.00	8.00	6.67	8.00	9.33	8.67	6.67	10.00	7.33	8.67	10.00	10.00	8.67	9.33

5-Sep-03	1	Control	8.67	10.00	8.67	9.33	7.33	6.67	8.67	8.00	9.33	7.33	8.67	8.00	5.33	8.67	7.33	7.33
5-Sep-03	2	Control	2.00	4.67	5.33	7.33	6.00	6.67	6.67	8.00	7.33	7.33	8.67	8.67	8.67	10.00	9.33	9.33

Table 4: Decomposition data for litter bag samples collected at Plaisir de Merle exposed from 20 October 2003 till 15 January 2004.

No	Treatment	Date in	Date out	Weight in (g)	Weight out (g)	Weight loss (g)	% Weight loss
1	Organic	20-Oct-03	15-Jan-04	11.1	6.7	4.4	39.64
2	Organic	20-Oct-03	15-Jan-04	10.8	7.8	3	27.78
3	Organic	20-Oct-03	15-Jan-04	10.3	7	3.3	32.04
4	Organic	20-Oct-03	15-Jan-04	8.6	6.2	2.4	27.91
5	Organic	20-Oct-03	15-Jan-04	13.2	8	5.2	39.39
6	Organic	20-Oct-03	15-Jan-04	10.6	7.9	2.7	25.47
7	Organic	20-Oct-03	15-Jan-04	11.1	6.4	4.7	42.34
8	Organic	20-Oct-03	15-Jan-04	13.5	8.4	5.1	37.78
9	Organic	20-Oct-03	15-Jan-04	9.6	5.6	4	41.67
10	Organic	20-Oct-03	15-Jan-04	10.3	6.4	3.9	37.86
11	Organic	20-Oct-03	15-Jan-04	10.7	6.5	4.2	39.25
12	Organic	20-Oct-03	15-Jan-04	12.5	10.3	2.2	17.60
13	Conventional	20-Oct-03	15-Jan-04	9.7	4.6	5.1	52.58
14	Conventional	20-Oct-03	15-Jan-04	9.7	6.8	2.9	29.90
15	Conventional	20-Oct-03	15-Jan-04	9.2	6.3	2.9	31.52
16	Conventional	20-Oct-03	15-Jan-04	10.8	7.7	3.1	28.70
17	Conventional	20-Oct-03	15-Jan-04	12.3	9.7	2.6	21.14
18	Conventional	20-Oct-03	15-Jan-04	9.4	6.8	2.6	27.66
19	Conventional	20-Oct-03	15-Jan-04	10.2	6.2	4	39.22
20	Conventional	20-Oct-03	15-Jan-04	12.7	7.1	5.6	44.09
21	Conventional	20-Oct-03	15-Jan-04	10.6	6.5	4.1	38.68
22	Conventional	20-Oct-03	15-Jan-04	10	5.9	4.1	41.00
23	Control	20-Oct-03	15-Jan-04	10.5	7.3	3.2	30.48
24	Control	20-Oct-03	15-Jan-04	11.5	8.4	3.1	26.96

25	Control	20-Oct-03	15-Jan-04	12.7	10.4	2.3	18.11
26	Control	20-Oct-03	15-Jan-04	9.3	7.1	2.2	23.66
27	Control	20-Oct-03	15-Jan-04	10.4	8.5	1.9	18.27
28	Control	20-Oct-03	15-Jan-04	11.4	10	1.4	12.28
29	Control	20-Oct-03	15-Jan-04	10.2	9	1.2	11.76
30	Control	20-Oct-03	15-Jan-04	10.2	8.5	1.7	16.67
31	Control	20-Oct-03	15-Jan-04	13.1	9.2	3.9	29.77
32	Control	20-Oct-03	15-Jan-04	10.1	9.3	0.8	7.92
33	Control	20-Oct-03	15-Jan-04	10.3	8.1	2.2	21.36