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Biodiversity of Soil Arthropods in Nigerian Institute for oil Palm Research (NIFOR), Nigeria

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ABSTRACT: A survey of soil arthropod fauna inhabiting Nigeria Institute for Oil Palm Research (NIFOR) was carried out from July-September 2012, with a view to determine the diversity and distribution of soil arthropods of the area. Two study stations were identified at the area, namely; Station one (Plantation site) and Station two (Control site). One thousand eight hundred and seventy-seven (1877) individual soil arthropods were recorded from both stations. These individuals were represented in 4 classes, 11 orders and 21 families which were collected and extracted using the pitfall trap method and the Berlese Tullgren Extractor Funnel. Data collected from the study stations were subjected to appropriate statistical analyses which included Simpson's index (Ds), the Shannon Wiener index (H'), the Shannon Diversity T-test and Evenness (E) to determine the diversity of the soil arthropod fauna. Station one (Plantation site), was the most diverse station (Ds=2.99) and (H'=1.84) while station two (Control site) having (Ds= 2.94) and (H'= 1.69) is the least diverse station which may be as a result of anthropogenic activities. The Order Hymenoptera and Family Formicidae (50.5%) and (38.7%) respectively were the dominant and abundant group in both stations with the Order Crustacea and Family Armadillidae (22.2%) and (1.63%) respectively were the least dominant and abundant in both stations. The soil arthropod fauna correlated positively with the soil organic carbon (r=0.16), soil moisture content (r= 0.26) and soil pH (r=0.60) while the soil temperature correlated negatively (r= -0.89) in both stations. This implies that soil arthropods increase with increasing soil moisture content and decreasing soil temperature.

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The soil represents a favourable habitat for microorganisms and it is inhabited by a wide range of them namely; fungi, algae, bacteria, arthropods and protozoa (Koehler, 1992). This is because there is a favourable amount of carbon energy source in the soil. There are millions of soil organisms in a mere handful of a typical garden soil; this single handful might well contain thousands of different species of bacteria, dozens of nematodes, plus a goodly assortment of various mites and other arthropods (Coleman, 2000). Arthropods are one of the most successful animals on the planet. They are one of only two animal groups that are very successful in dry environment, the other being the amniotes. About one million species have been described making up more than 80% of all describe animal species (Beatle and Oliver, 1994). They phylum Arthropod consists of organism such are a dominant group of major ecological importance in the soil. When present in the soil, they are known as "Soil Arthropods". There are approximately about 900,000 species of Arthropods which have been recorded and considering the relatively small size of most members, it is possible that many Arthropods remain undescribed (Choi, 1996).

They are five major classes of arthropods and each class can be separated based on their shared characters, namely; Arachinda (Scorpions, Spiders, Mites, Ticks, etc); Crustacea (crabs, lobsters, shrimps, isopods, water fleas, copepods, etc); Diplopoda (Millipedes); Chilopoda (Centipedes) and Insecta (Hexapoda = all insects). Major groups of soil arthropods that are of significant importance in many terrestrial ecosystem food chains and webs include; Acarina, Collembola, Myriapods, Symphylla (garden centipedes) and insects from several orders (Badejo, 1982). Wallwork (1970) stated that the Acarcina and Collembolans usually account for 90% of the soil arthropod fauna. According to Hopkins (1997), soil organisms are basically classified into 3 main groups based on the size of organisms the feeding habits, mode of locomotion and the location in soil based on depth. These three groups are: (a) Micro-fauna: these are organisms that live in burrows on the soil surface, in water films and on soil particles with size ranges from 1-100µ. Examples are yeast, bacteria ciliates, rotifers, etc. (b) Meso-fauna: these are organisms that of soil and have a size range of 100µ - 2mm. Examples are collembolan, Isopoda, Nematodes, Insect larvae (Coleoptera), etc. (c) Macro-fauna: These are arthropods which live in burrows with diameter more than 2 mm. Size range is 2 mm - 20 mm. e.g., fly larva, coleoptra, millipedes, centipedes etc. The objectives of this study are to: (1) Collect, extract and sort out soil arthropods in the study area. (2) Preserve and prepare slides of the samples collected. (3) Identify, using appropriate identification keys, the preserved samples and those prepared on slides. (4) Measure and record the abiotic

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parameters such as soil temperature, soil pH, air temperature, humidity.

MATERIALS AND METHODS

Study Area: The study area is the major oil palm plantation in Nigeria, located at the Nigeria Institute for Oil Palm Research (NIFOR), with its main station consisting about 1735 ha land area located near Benin City about 29km from the city centre, off Benin-Akure Road, Nigeria (Ughah and Nwawe, 2008).

This study was carried out at the Nigerian Institute for Oil palm Research (NIFOR) between July-September 2012. The institute is situated on the southern part of Nigeria, with its coordinates (N06.56017^{o}, E005.62372^{o}). It's located at the outskirt of Benin City (along the Benin-Akure road), Edo state (6^{o}38N, 5^{o}30E) in the rain forest belt of the humid tropics. The topography of the location is partly flat with few hills to the east and north-east, about 400-450 m above sea level. The climate of the region is characterized with daily mean temperature range from 26^{o}C to 32^{o}C and annual heavy rainfall of about 80-120 cm for most part of the year. Weather information from metrological report reveals the weather conditions does not conform to any regular annual regime. However, there are two distinct seasons in this region; the rainy season and the dry season lasting from April - September and October - March respectively. These periods are not strictly the same yearly.

*Sampling Sites:*There were two sampling sites with each having two plots each. Bringing it to a total of 4 plots within the study area (10 × 20 m) and (10 × 10 m). There were two stations with four substations were soil samples were collected fortnightly throughout the duration of the project work. The study was carried out in field 16 (which was planted in 1993) located inside the oil palm plantation with each oil palm tree about 29 m apart equally and marked station one, while a control station (in an open grass field behind field 63) located at the north end of the oil plantation close to the Head Office was called station two both at coordinates (N06.55858, E005.62385).

Collection and Extraction: Soil samples from the two stations were collected with a tubular sampler measuring 0-60 cm in length. The tubular sampler is pushed down into the soil to about 15 cm depth from the top soil (Active region) by applying pressure on the handle with both hands and then moved anti-clockwise to avoid breakage from the sampler. Samples were collected every two weeks. Soil samples were placed in a labelled black cellophane bag at the site of collection and this exercise was carried out between the hours of 8.00 am -10.00 am in the morning. Dates and temperature were also recorded. Soil samples were also collected by using pitfall trap method; containers measuring about 4 litres were used and about 20 cm deep of soil was dug in each stations since it aids in collecting diverse numbers of surface dwelling, nocturnal and flying insects and it is also a cheap method (Ward *et al.*, 2001; Holland and Reynolds, 2005) . The container is covered with plastic tops suspended by three sticks measuring about 6 - 8 cm which are dug into the soil. About 2 litres of water was placed in the containers and were administered 1ml of Insecticides (Rocket Insecticides, contain chlorpyrifos 20% E.C (emulsifiable concentrate) in order to prevent the escape of organisms caught in the containers. The containers were removed after 48 h to collect organism. A total of 8 samples were collected every two weeks using the tubular sampler and 14 pitfall traps were constructed.

The extraction methods were designed to suit size, behaviour and structural patterns shown by these organisms (Wallwork, 1970). Samples were taken to the Berlese Tullgren extracting machine immediately after collection, the Berlese Tullgren Funnel extractor is the best extraction method for extracting soil arthropods with efficiency of 90% (Hopkins, 1970; Frith and Frith, 1990; IIoba and Ekrakene, 2008).

About 5 cm of the soil sample was placed in the sieve mesh of size 1 mm at the top of each funnel and the organisms were collected in plastic containers 7 cm in diameter. Each of the plastic containers contains 70% alcohol. After 48 h, they were sorted and transferred into sorting containers containing 70% alcohol.

Sorting, Preservation and Slide Preparation: After the organisms were extracted and collected, they were sorted. This was done under a binocular dissecting microscope were individual number of species was counted at 20 × magnification and species were removed from debris by suction using sucking pipette and placed in a glass specimen bottle containing 70% alcohol. Large species were picked and preserved in formalin or pinned in an insect box. As a result of the microscopic nature of many arthropods, they are not readily identifiable unless, they are mounted on a microscopic slide and examined at high magnification using a compound light microscope under phase contrast illumination. The arthropods were mounted in Canada balsam.

Measurement of Parameters: The parameters that were monitored and measured include; soil pH, soil moisture content, air and soil temperature, soil organic carbon, soil particle size determination, soil nitrogen, soil phosphorus, soil Exchangeables Cations (Na, K, Ca, Mg).

Soil Ph: The pH meter was calibrated with buffer solution of pH 4.0, 7.0 and 10.0 respectively. 20g of the processed soil samples was placed in a 500ml beaker, 20ml of distilled water was added to it and stirred in the beaker and was allowed to stand for 30 minutes with occasional stirring with glass rod, the electrodes of the pH meter was inserted into the partly settled mixture and pH was read on the meter.

*Soil Moisture Content***:** Fifty gram (50 g) of soil samples taken from the stations were left in an oven for 24 hours at 100^0C. Then the samples were weighed and the moisture content was thus calculated;

$$\text{Soil Moisture Content \%} = \frac{\text{loss in weight} \times 100}{\text{Initial weight}}$$

Where loss in weight = Initial weight- final weight
Soil moisture content was taken biweekly.

Soil Temperature: Temperature of the soil was taken by digging a hole in the soil (10 cm) and the thermometer was inserted and left for 5 min and then the reading is taken. The reading was taken every day and recorded. The thermometer used is called an earth thermometer and has varying size depths; 5 cm, 10 cm, 20 cm, 30 cm, 50 cm and 100 cm.

Soil Organic Carbon The soil organic carbon is determined using modified Walkley Black, 1934 method. Five gram (5 g) of the processed soil was ground using porcelain mortar and pestle to pass through 0.5 mm sieve. 0.50 g soil samples were weighed into 250 ml Erlenmeyer. Flask and 10ml of 0.4M $K_2Cr_2O_7$ solution was added into the flask swirled gently to disperse the soil. Twenty millilitres (20 ml) of concentrated 20ml of Conc. H_2SO_4 was rapidly added using an automatic pipette; directing the stream into the suspension.

The flasks were immediately swirled gently until soil and reagents were thoroughly mixed and later swirled vigorously for one minute. The flasks were allowed to stand on asbestos sheets for 30 minutes, 60ml of distilled water was introduced into the flasks. Five to six drops of 1% diphenylamine indicator was added and the content titrated against 0.5M ferrous ammonium sulphate as the end point approached, the solution took on dark blue colour, at this point, the titrant was added drop-wise until the colour change sharply from dark blue to green in reflected light against a white background, the blank titration was done to standardize the $K_2Cr_2O_7$ in the same manner but without the soil samples.

$$\text{Calculation: \% C in soil} = \frac{M\,(V1-V2) \times 0.32}{Ws}$$

Where, M= Molarity of the $(NH_4)_2FeSO_4$.V1= Volume of $(NH_4)_2FeSO_4$ required for the blank (ml) V2= Volume of $(NH_4)_2FeSO_4$ required for the sample (ml). Ws= Weight of soil sample (g) 0.32= 3 × 10-3 × 100 × 1.3. Where 3 is equivalent weight of carbon and 1.3 is the correction factor based on assumption that there is 77% recovery. Organic matter (%) = Organic carbon × 1.729. where 1.729 is a constant.

*Identification of samples***:** Specimens' identification was done using identification keys, consulting zoological taxonomist, past works, NIFOR entomological museum and internet.

RESULTS AND DISCUSSION

The collection of soil arthropods fauna lasted for a period of 3 (Three) months (July-September) and 21 families were recorded from 4 classes and 11 orders of which 12 taxa were identified of the phylum arthropod. The results of bi-weekly collection of soil samples of the arthropods in the two stations include;

Table 1 shows the monthly distribution of soil arthropods fauna found in station 1 and 2 (which is the main site). In the station one, four classes of arthropods was identified and 1,080 species of soil arthropods was collected from this station, of which the class Insecta had the highest frequency of species with 826 (76.5%) individuals in total throughout the (80.8%) individuals in total throughout the sampling period, of which the prominent family is the family Formicidae with 249 (38.7%) individuals and smallest been the Order Orthoptera and of the Family Tetrigidae with only 3 (4.69%) individuals throughout the sampling period. While the smallest class of soil arthropods is the class with 13 (1.63%) individuals throughout the sampling period.

sampling period, of which the representative order is the Hymenoptera of which the prominent family is the Family Formicidae with 415 (50.5%) individuals and smallest been the Order Collembola and of the family Tomoceridae with only 2 (0.24%) individuals throughout the sampling period. While the smallest class of soil arthropods is the class Crustacea with 24 (2.22%) individuals of this contains only one family which is the Family Armadillidae.

Station two (control site) show four classes of arthropods were also identified and 797 individuals of soil arthropods were collected (Table 1). The class Insecta also had the highest frequency of species with 644

Table 2 shows the comparison between the methods employed during collection and extraction of the soil arthropods throughout the sampling periods. The methods were compared in order to check the efficiency of both methods; they include the Pitfall Trap Method which according to Holland and Reynolds, (2005); states the such method cannot be use to estimate absolute abundance population per

unit area in multi group ecological approach involving ground surface dwelling arthropods. While Anu and Thomas, (2007); stated that the most useful standard arthropod collection method for ecological studies is the use of Core or tubular sampler which can take less active soil arthropods that are associated with moistures sheltered areas and then extracted with an efficient extractor (which is the Berlese Tullgren Extractor) . Thus, in this table the total numbers of soil arthropods collected from both methods were recorded. In the Pitfall Trap Method used in station one, a total of 431 species were recorded while in Station two recorded a total of 361 species. While the Berlese Tullgren Extractor method recorded a total 649 individuals in station one and 436 individuals in station two. using Pearson's Correlation. Also, the soil organic content and the pH level tends to be positively correlated (r=0.90) which is also significant (<0.05). Also the same condition in the station two, with positive correlation between pH and organic carbon content (r=0.68). In general a total of 1877 individuals of soil arthropods were collected and extracted throughout the sampling periods.

Table 3 shows the mean distribution of soil arthropods based on order category to their corresponding physiochemical parameters which includes soil pH, soil moisture content (%), soil temperature and the soil organic carbon content. The soil moisture content in station one increased with a decrease in soil temperature with a negative correlation (r= -0.32) with a significance (<0.05)

Table 1: Monthly distribution of soil arthropod fauna in station 1 and station 2

Station 1						
Class	**Order**	**Family**	**July**	**August**	**September**	**Total**
Insecta	Hymenoptera	Formicidae	120	135	160	415
	Collembola	Isotomidae	18	18	25	61
		Entomobryidae	23	13	11	47
		Smithuridae	13	19	2	34
		Tomoceridae	1	1	0	2
	Coleoptera	Byrrhidae	9	10	14	33
		Carabidae	18	14	8	40
		Cerambycidae	4	4	6	14
		Chrysomelidae	6	8	2	16
		Curculionidae	27	5	3	35
		Tenebrionidae	3	1	10	14
	Isoptera	Rhinotermitidae	20	14	8	42
	Orthoptera	Gryllidae	13	8	3	24
		Tetrigidae	2	6	4	12
	Dipteran Larvae	Unidentified	13	15	9	37
Arachinda	Acarina	Mesostigmatidae	22	8	24	54
		Oribatidae	17	29	19	65
		Lycosoidae	21	13	9	43
Myriapoda		Polydesmidae	12	16	3	31
		Symphylidae	4	6	7	17
		Spirostreptidae	6	11	3	20
Crustacea	Isopoda	Armadillidae	5	10	9	24
	Total		377	368	339	1080
Station 2						
Insecta	Hymenoptera	Formicidae	103	89	57	249

	Collembola	Isotomidae	15	19	9	43
		Entomobryidae	13	11	20	44
		Smithuridae	13	17	6	35
		Tomoceridae	5	2	0	7
	Coleoptera	Byrrhidae	2	4	4	10
		Carabidae	24	12	9	45
		Cerambycidae	8	4	3	15
		Chrysomelidae	4	12	5	21
		Curculionidae	18	12	9	39
		Tenebrionidae	6	5	11	22
	Isoptera	Rhinotermitidae	25	19	10	54
	Orthoptera	Gryllidae	17	9	9	35
		Tetrigidae	2	`1	0	3
	Dipteran Larvae	Unidentified	9	15	5	29
Arachinda	Acarina	Mesostigmatidae	10	17	6	33
		Oribatidae	13	17	17	47
		Lycosoidae	2	2	2	4
Myriapoda		Polydesmidae	4	10	16	30
		Symphylidae	2	0	0	2
		Spirostreptidae	0	2	10	12
Crustacea	Isopoda	Armadillidae	4	5	4	13
	Total		302	284	212	797

Table 2: Comparison of soil arthropod fauna in station 1 and station 2 using Berlese Funnel Extractor and Pitfall Trap Method

Station 1			
Orders	Months	Berlese Extractor	Pitfall Trap Method
Hymenoptera	July	76	44
	August	98	37
	September	104	56
Collembola	July	29	26
	August	28	23
	September	21	17
Coleoptera	July	42	25
	August	33	3
	September	34	9
Isoptera	July	0	20
	August	3	11
	September	3	5
Orthoptera	July	0	15
	August	0	14
	September	0	7
Dipteran Larvae	July	13	0
	August	15	0
	September	9	0
Acarina	July	25	35
	August	28	22
	September	37	15

Myriapoda	July	9	13
	August	24	9
	September	8	5
Crustacean	July	1	4
	August	6	4
	September	3	6
	Total	431	649
Station 2			
Hymenoptera	July	63	40
	August	57	32
	September	38	19
Collembola	July	20	26
	August	23	26
	September	19	16
Coleoptera	July	31	31
	August	21	26
	September	15	26
Isoptera	July	1	24
	August	2	17
	September	2	8
Orthoptera	July	9	13
	August	4	5
	September	2	7
Dipteran Larvae	July	9	0
	August	14	1
	September	5	0
Acarina	July	19	6
	August	30	6
	September	23	2
Myriapoda	July	3	3
	August	6	6
	September	13	13
Crustacean	July	2	2
	August	1	4
	September	2	2
Total		361	436

Table 3: Mean distribution of total soil arthropods in their order category in Station 1 and 2 corresponding physiochemical parameter

Station 1					
Order	July	August	September	Total	Mean ($\bar{X}$+S.D)
Hymenoptera	120	135	160	415	138.33 ± 20.21
Collembola	55	51	38	144	48.00 ± 8.89
Coleoptera	67	42	43	152	50.67 ± 14.15
Isoptera	20	14	8	42	13.67 ± 6.51
Orthoptera	15	14	7	36	12.00 ± 4.36
Dipteran larvae	13	15	9	37	12.33 ± 3.06
Acarina	60	50	52	162	54.00 ± 5.29
Myriapoda	22	33	13	68	22.67 ± 10.02
Crustacean	5	10	9	24	8.00 ± 2.65
Mean Soil pH	5.6	5.5	5.03		
Mean Soil Temp (^{o}C)	28.5	25.7	26.8		
Mean soil moisture Content (%)	87.5	92	84		
Soil Organic Carbon Content	0.85	0.82	0.79		
Station 2					
Hymenoptera	103	89	57	249	83.00 ± 23.58
Collembola	46	49	35	130	43.33 ± 7.37
Coleoptera	62	49	41	152	50.67 ± 10.60
Isoptera	25	19	10	54	18.00 ± 7.55

Orthoptera	22	9	9	40	13.33 ± 7.51
Dipteran larvae	9	15	5	29	9.67 ± 5.03
Acarina	25	36	25	86	28.67 ± 6.35
Myriapoda	6	12	26	44	14.67 ± 10.26
Crustacean	4	5	4	13	4.33 ± 0.58
Mean Soil pH	5.35	6.53	5.65		
Mean Soil Temp (^{o}C)	28.3	26.4	27.1		
Mean soil moisture Content (%)	90	89	90		
Soil Organic Carbon Content (%)	0.69	0.73	0.63		

The environment exerts tremendous effects on soil, its nutrients status and vegetation present. The kind of litter the vegetation produces and the ability of the plants and animals to return the nutrients to the soil, all have direct correlation with the abundance, distribution and species composition of the soil arthropod fauna. In addition, various environmental factors such as the composition of the soil moisture content, soil temperature, pH, vegetation cover etc., influence to a high magnitude, the soil fauna population (Wallwork, 1970). Soil arthropods are not evenly distributed through space as could be observed in other organisms in life. The average air temperature at station one and station two fluctuated across the sampling months with station one having the higher average air temperature value across the sampling periods as compared to station two (26.04^{o}C : 25.93^{o}C).

In the two stations, the fluctuation in average soil temperature throughout the sampling periods did not show much significant difference but did not followed the general pattern of fluctuation of air temperature with station one having less average soil temperature value than station two i.e. (27.34^{o}C:27.57^{o}C). The average soil temperature generally fluctuated throughout the sampling periods with significance in both stations and this maybe as a result of seasonal fluctuations from dry to rainy season. The total number of soil arthropods collected using Pearson correlation coefficient, correlated negatively with soil temperature in station one (r=-0.89) and in station two (r=-0.99) throughout the sampling periods.

The soil moisture content of the soil samples show a positive correlation in the sample stations but the average soil moisture content in station one was higher than that of station two across the sampling periods (88.2%:87.3%) and this also affected the distribution and abundance of soil arthropods fauna in both stations, with station one having the larger number of species abundance (1080:797) The soil moisture content showed a negative correlation with the soil temperature (r=-0.32) but showed a positive correlation with the number of soil arthropods (r=0.16) and this could be as a result of increased rainfall throughout the sampling periods and availability of food materials for the soil arthropods such as fungi, bacteria and microflora which serves as excellent food source for various arthropods (Seatedt, 1984) and also most of these soil inhabitants are poorly adapted in periods of low moisture and high temperature particularly in moist forest environment and can only survive only in narrow range of microclimatic variations (William, 1999). Most soil arthropods particularly the Crustaceans and Myriapods lack an impermeable cuticle when the moisture content level is low in their environment and evaporation from their body surface and respiratory organ leads to dehydration (Humphrey, 1995).

The soil pH also affected soil arthropod distribution and abundance in both stations with a relative negative correlation with the soil moisture content in both stations (r=-0.12) and a positive correlation with the soil organic carbon content of the soil in both stations. The increase in soil pH as recorded reflects changes in chemical properties peculiarly the carbon content of the soil and this slightly determines the abundance of the soil arthropods (Michelle, 2004). The naturally occurring chemical substances in the soil called humates, stimulates microbial activities. These humates which contains carbon and other organic stimulates serves as energy source for microbes which serves as food for the arthropod species.

The soil carbon content tends to decrease across the stations across the sampling months and this maybe as a result of continuous rainfall which causes an increase in soil moisture content during the sampling periods (July-September). This may have brought about the reduction of the total soil organic carbon matter.

It was also found that rainfall and moisture content also helped in the distribution and abundance of soil arthropods especially in the plantation station (station one) where this organisms enjoy living in moist and shady areas and do move significantly away from the soil surface when it is unfavourable especially during periods of high temperature (as from 11am, it was discovered that soil arthropods where absent from the 0-5cm depth of the soil on a non-cloudy day but are present in minute quantity on a cloudy day). Thus, environmental factors and other physiological parameters do place a major role in the distribution of soil arthropods and since their importance is beginning to come up to limelight it is necessary that their diversity conservation be placed in mind. Though they have not been regard majorly in terms of

conservation due to their minute sizes their conservation is necessary as they play a key role in ecological processes and as such, entomologists should create means in which population of arthropods species especially soil arthropods diversity and distribution are kept in check to avoid any flaw in ecological balance.

Basically the increase in the total number of arthropods discovered maybe as a result of major increase in the soil moisture content due to increasing rainfall and minute fluctuation in temperature. The diversity indices of the arthropods discovered where analysed. Using the Shannon-wiener and Simpson's index, across the two stations: Simpson's index (D_s) = 2.99 in station one across the sampling period while in station two, the Index (D_s) = 2.94, using a diversity t-test, the *p*-value between the two stations was significant (<0.05). This signifies that the station one is basically more diverse or rich in soil arthropods than the station two since station one is a plantation site which has a high moisture content coupled with scattered moist litters around which provides adequate food materials for these organisms and they promote the formation of humus in the soil and aid in maintaining the soil structure and fertility (Coleman and Crossley, 2004) and which impact plant performance, plant competition and thus plant community composition and as a result of high anthropogenic activities in the control site (station two) .

Also the Shannon-wiener diversity index for both stations signifies that station one is more diversified than station two i.e. (H'=1.84) to (H'=1.69), but the most abundant family in both stations is the family Formicidae which has 415 (50.5%) individuals in station one and 249 (38.7%) individuals in station two in which most members of the group are majorly predatory and phytophagous. Soil biodiversity influences a large range of ecosystem processes that contributes to the sustainability of life on earth (Ward, 2001). The population of soil arthropods is determined by certain factors which include; the availability of resource materials such as organic matter, the macroclimate disposition and degree of disturbance that direct them.

Conclusion: Thus from this study, it was seen that the presence of arthropod fauna in a particular ecosystem tends to create a lot of balance in the transfer of food materials within the ecosystem. They act as ecological protectors in that most arthropods perform beneficial function in the soil. They tend to increase the surface area of the soil by shredding dead plant matters and readily burrowing into coarse woody debris; stimulate growth of mycorrhize, decomposition of organic matter, provide mineral nutrients for plants, enhance soil aggregation, burrow and stimulate plant species succession. For instance the abundance and diversity of collembola have been used widely to assess the environmental impact of range pollutants on soils.

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