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# Species compositions and relative abundance of soil arthropods in Leventis agricultural training school maize (*Zea may*) farmland, Yaba, FCT Abuja Nigeria

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**Abstract**
This study was conducted to determine the species compositions and relative abundance of soil arthropods in Leventis agricultural training school maize farmland Yaba, FCT, Abuja Nigeria from 28th of January, 2018 to December 28th, 2018. Soil arthropods were sampled using pitfall trap of height of 14.40cm and diameter 9.50cm with an overlap cover of 11.00cm held attached to the trap by two iron rod of length 1.65cm. A total of 3202 soil arthropods were sampled belonging to 7 orders, 8 families and 35 species. The Order Coleoptera had the dominant taxa of 3099 (96.78%), while Orthoptera had the least taxa of 25 (0.78%). In terms of family dominance, Scarabaeidae had the highest taxa of 2067(64.96%) while Buprestidae, Acrididae, Lygaeidae and Tiphiidae has the least taxa of 1(0.03%). In species dominance, *Hister monitor* (Lewis) had the highest of 901 (28.14%) followed by *Copris sp.* 879 (27.45%) and *Gymnopleurus fulgidus* 719 (22.45%). In the Monthly sampling, the month of June had the highest number of taxa 2016 (62.96%) followed by the month of May 381(11.91%), while the month of December had the least number of taxa 1(0.03%). From these results, it was observed that stable rainfall and vegetation are good predictors of soil arthropods abundance in a particular farmland.

**Keywords:** soil arthropods, species composition, relative abundance, modified pitfall trap and agriculture

## 1. Introduction
Soil arthropods sometimes called bugs majorly dwell in the soil and represents about 85% of the soil fauna (Bass et *al.*, 2003; Culliney, 2013; Esenowo *et al.*, 2014) [3, 7, 8]. They are very important in agro-ecosystem because of the various functions they perform such as; decomposition of dead organic matter which unlock the nutrient into the soil and these nutrients are utilized by crops to increase their quality and quantity and also enhance their structures (Trombetti and Williams, 1999; Wardle *et al.*, 2004; Bardgett, 2005) [18, 19, 2]. Soil arthropods aerate the soil which enhanced soil fertility, structure and texture and through that create micro-habitats for other fauna (Agwunobi and Agwumba, 2012). Soil arthropods through their decomposition activities maintained the food chain therefore they sustained the agro-ecosystem (Esenowo *et al.*, 2014) [8]. Since the 20th century, soil arthropods have been used as good bio-indicators for various agricultural impacts on the agro-ecosystem (Cairns and Pratt, 1993; Brown, 1997; Gardi and Jeffery 2009) [6, 5, 10]; Spiders are good indicators for early detection of insecticide side-effects on predatory arthropods (Everts *et al.*, 1989) [9], carabid beetles are bio-indicators of crop management (Holland and Luff, 2000) [14] and ant species are indicators of agro-ecosystem and grassland conditions (Peck *et al.*, 1998) [17]. The aim of the study was to determine the species composition and relative abundance of soil arthropods in Leventis agricultural training school Maize (*Zea may*) farmland, Yaba, FCT Nigeria for proper conservation measures.

## 2. Materials and Methods
### 2.1 Study Area
The study was carried out in Leventis agricultural training school Maize (*Zea may*) farmland located at Yaba, Abaji Area Council, Federal Capital Territory (FCT) Abuja Nigeria. This school was established on 27th May 2007 and commenced operation on the 29th of May, 2008 with 28 trainees all indigenes of FCT. Yaba is 101km from Abuja city gate and 15km from Dangara Junction along Lokoja – Abuja expressway. Yaba lies on the southern fringes of the guinea savannah belt with an elevation of 92m above sea level and a coordinates of 8˚38ʾ47.4ʺN and 6˚48ʾ01.1ʺE. It has an annual rainfall of between 1000 and 1200mm and temperature between 22° C and 30° C which allow for mono-modal rain fed cropping season from May to October. The vegetation cover is made up of a mixture of shrubs and scattered trees and has a population of 12,500 (NPC, 2006), which are predominantly farmers and fishermen as a result of River Gurrara an offshoot of River Niger that cut across it entrance.
The Leventis agricultural training farmland is about 2km from the training school and is 50 hectare arable land made up of sandy loamy soil. The land is divided into sections of 10 hectare each, and each section is used for cultivation of different crops such as; Maize (*Zea may*, Linn.) Yam (*Dioscorea sp.*, Linn.), Benniseed (*Sesanum indicum*, Linn.) Melon (*Cucumis melo*, Linn.) and Cassava (*Manihot sp.*, Linn.). But the maize section was used for this study because it is the most dominant crop cultivated in Yaba.

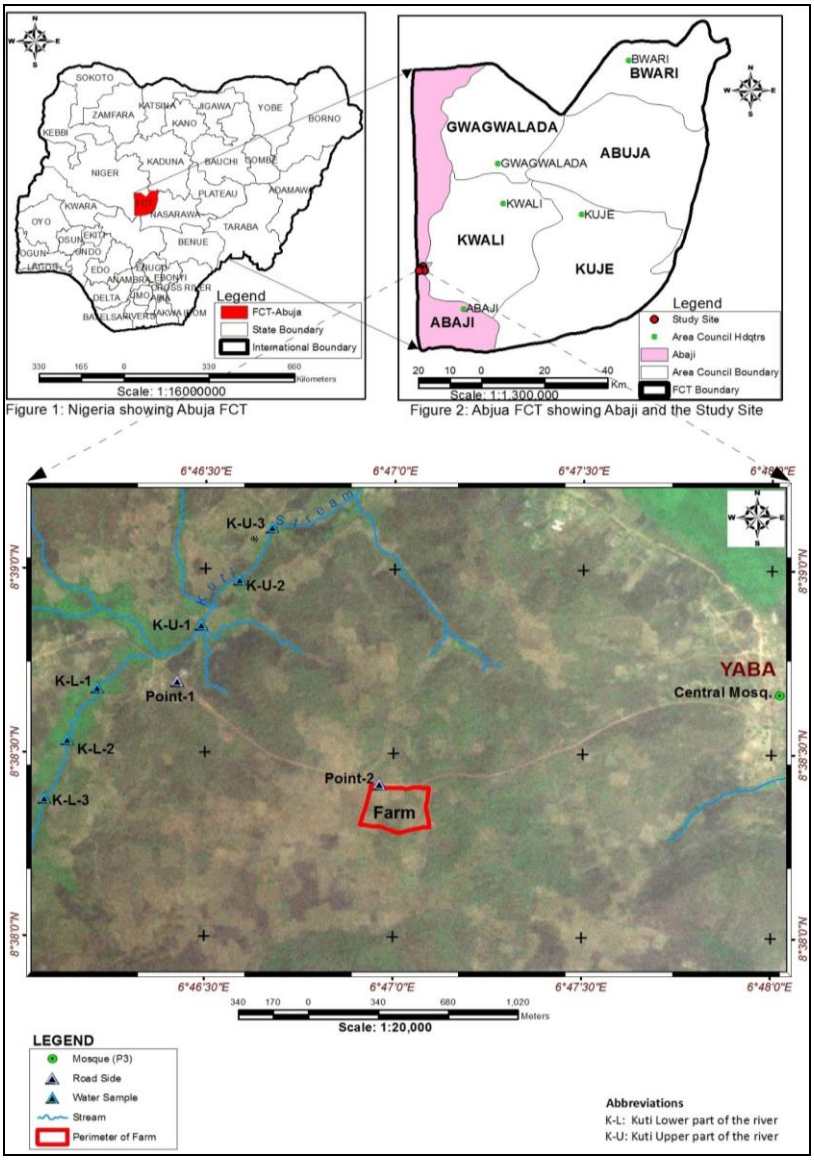


Figure 1: Nigeria showing Abuja FCT

Figure 2: Abjua FCT showing Abaji and the Study Site

**Fig 1:** Satellite image map showing Kuti Stream on the Farm Site

### 2.2 Description of Sampling Plot and Collection of Soil Arhropods

A portion of the maize farmland which covered an area of 110m×150m (16,500m$^2$) measured with Global Positioning System (GPS, Garmin…) was sampled during the study. The portion was divided into three (3) sets which contained four (4) plots each of 30×30m$^2$ and a distance of 10m between each to ensure even distribution of pitfall traps. Each plot had two pitfall trap of height of 14.40cm and diameter 9.50cm with a cover of 11.00cm made from a thin sheet metal, painted black and held attached to the trap by two iron rod of length 1.40cm. The cover overlap the surface of the trap so as to prevent rainfall from destroying samples collected during rainy season. The trap was set 15m apart from each other in each plot with equal level to the surface of the soil. A total of twenty four pitfall traps were used throughout the study. Samples were collected monthly with forcep into a well labeled specimen plastic container that contained 70% formaldehyde. Collection was done both before and after cultivation of hybrid six maize seedlings on the farmland as advocated by (Green, 1993; modification) [12]. Samples collected before cultivation started from January 28th to June 28th, 2018. Glyphotex (A glyphosate based herbicides) was applied on 2nd of July, 2018 to kill weeds such *Hyptis suaveolens* (Linn), *Calotropis procera* (Linn) and *Euphorbia hirta* (Linn) also called the Asthma plants were identified unevenly distributed on the sampled plots. The herbicides application was done according to the manufacturer's instructions with Knapsack and allowed to penetrate the weeds for two weeks. The farmland was deeply plough by tractor and planting of maize seedlings was done on the 23rd of July, 2018. Samples collection after cultivation started from July 28th and ends in December 28th 2018. Soil arthropods collected were preserved and taken to crop protection entomology laboratory Ahmadu Bello University, Zaria for identification to species level using cross matching.

### 2.3 Statistical Analysis

Data obtained were subjected to descriptive statistics (simple percentage). The total number of each taxa and species were summed and also the Relative abundance for each species, order and months were calculated using the formula by Braimah, J. A. and Popoola K.O.K (2018) [4] as shown below;

Relative abundance =

$$\frac{\text{Number of arthropods of a particular species or order}}{\text{Total number of arthropods species sampled}} \times 100\%$$

## 3. Results

**Table 1:** Species composition and relative abundance of soil arthropods

| Order | Family | Species | Number Trapped | Relative Abundance (%) |
|---|---|---|---|---|
| Chilopopda | Polydesmoidae | *Sprostreptus sp.* | 8 | 0.25 |
| Coleoptera | Buprestidae | *Chrysobothris wilkinson* (Thery). | 1 | 0.03 |
| Coleoptera | Carabidae | *Anoncopeucus curvipes* (Dej). | 3 | 0.09 |
| Coleoptera | Carabidae | *Aulacorhynchus sp.* | 1 | 0.03 |
| Coleoptera | Carabidae | *Chlaenites splendidus* (Dej). | 1 | 0.03 |
| Coleoptera | Carabidae | *Dichaetochilus vagansi* (Dej) | 1 | 0.03 |
| Coleoptera | Carabidae | *Graphipterus sp.* | 7 | 0.22 |
| Coleoptera | Carabidae | *Scarites gagatinus* (Dej). | 1 | 0.03 |
| Coleoptera | Carabidae | *Scarites (distichus) gagatinus* (Dej). | 1 | 0.03 |
| Coleoptera | Carabidae | *Stereostoma sp.* | 3 | 0.09 |
| Coleoptera | Carabidae | *Systolocranius sp.* | 1 | 0.03 |
| Coleoptera | Carabidae | *Tomochilus carbonatus.* (Chaud). | 1 | 0.03 |
| | **Subtotal** | | 20 | 0.62 |
| Coleoptera | Chrysomelidae | *Asbecesta nigripennis.* (Lab). | 3 | 0.09 |
| Coleoptera | Chrysomelidae | *Asbecesta transversa.*(Allard). | 6 | 0.19 |
| Coleoptera | Chrysomelidae | *Aulocophora vinula.* (Eric). | 1 | 0.03 |
| Coleoptera | Chrysomelidae | *Leptaulaca fassicallis* (Thoson) | 1 | 0.03 |
| Coleoptera | Chrysomelidae | *Platyxantha spp.* (Nr. Bicolor Jac). | 1 | 0.03 |
| | **Subtotal** | | 12 | 0.37 |
| Coleoptera | Curculionidae | *Gasteroclisus rhomboidalis* (Boh). | 1 | 0.03 |
| Coleoptera | Curculionidae | *Pycnodactylus alboglivus.* (Gyll). | 1 | 0.03 |
| | **Subtotal** | | 2 | 0.06 |
| Coleoptera | Dermestidae | *Attagenus sp.* | 1 | 0.03 |
| Coleoptera | Dermestidae | *Dermestes frischii* (Kug). | 40 | 1.25 |
| Coleoptera | Dermestidae | *Dermestes maculatus* (Deg). | 7 | 0.22 |
| | **Subtotal** | | 48 | 1.49 |
| Coleoptera | Histeridae | *Hister monotor* (Lewis) | 901 | 28.14 |
| Coleoptera | Nitidulidae | *Aethina sp.* | 48 | 1.49 |
| Coleoptera | Scarabaeidae | *Anachalcas sp.* (Convexus Bah) | 4 | 0.12 |
| Coleoptera | Scarabaeidae | *Aphodius sp.* | 1 | 0.03 |
| Coleoptera | Scarabaeidae | *Catharsius sp.* | 252 | 7.87 |
| Coleoptera | Scarabaeidae | *Copris megac eratoides*(Waterhouse) | 3 | 0.09 |
| Coleoptera | Scarabaeidae | *Copris sp.* | 879 | 27.45 |
| Coleoptera | Scarabaeidae | *Gymnopleurus fulgidus* (Olivier) | 79 | 2.47 |
| Coleoptera | Scarabaeidae | *Gymnopleurus sp.* | 719 | 22.45 |
| Coleoptera | Scarabaeidae | *Heliocopris staudingeri* (Kolbe) | 12 | 0.37 |
| Coleoptera | Scarabaeidae | *Onthophagus sp.* | 6 | 0.19 |
| Coleoptera | Scarabaeidae | *Scarabaeus gangeticus* (Cast). | 112 | 3.49 |
| | Subtotal | | 2067 | 64.55 |
| Total | | | 3099 | 96.78 |

**Table 2:** Species Composition and Relative abundance of Soil Arthropods

| Order | Family | Species | Number Trapped | Relative Abundance(%) |
|---|---|---|---|---|
| Diptera | Acrididae | *Catantops haenlorrhoidalis* (Kraus) | 1 | 0.03 |
| Diptera | Drosophilidae | *Mycodrosphila sp.* | 30 | 0.94 |
| **Total** | | | **31** | **0.97** |
| Hemiptera | Lygaeidae | *Dieuches sp.* | **1** | **0.03** |
| Hymenoptera | Chalcididae | *Brachymeria sp.* | **2** | **0.06** |
| Hymenoptera | Formicidae | *Camponotus perrisi* (For). | 4 | 0.12 |
| Hymenoptera | Formicidae | *Camponotus sericeus.* (Fab) | 2 | 0.06 |
| Hymenoptera | Formicidae | *Compenetus acrapinensis* (Mayr) | 1 | 0.03 |
| Hymenoptera | Formicidae | *Componotus vestitus.* (Smith) | 1 | 0.03 |
| Hymenoptera | Formicidae | *Crematogaster (Acrocoelia) sp.* | 8 | 0.24 |
| Hymenoptera | Formicidae | *Pheidole sp.* | 6 | 0.19 |
| | **Subtotal** | | **22** | **0.69** |
| Hymenoptera | Mutillidae | *Trogaspidia sp.* | **10** | **0.31** |
| Hymenoptera | Tiphiidae | *Elis sp.* | **1** | **0.03** |
| **Total** | | | **35** | 1.09 |

| | | | | |
|---|---|---|---|---|
| Isoptera | Termitidae | *Psococerastes sp.* | **3** | **0.09** |
| Orthoptera | Acrididae | *Acrida bicolor* (Thumb). | 1 | 0.03 |
| Orthoptera | Acrididae | *Calephorus compressicornis.* (Late) | 1 | 0.03 |
| Orthoptera | Acrididae | *Criotocatantops annulatus* (Uvarov) | 1 | 0.03 |
| Orthoptera | Acrididae | *Catantops sp.* | 4 | 0.12 |
| | **Subtotal** | | **7** | **0.22** |
| Orthoptera | Gryllidae | *Acheta lefevrei* (Chp) | 2 | 0.06 |
| Orthoptera | Gryllidae | *Gryllodes sigillatus* (Walker) | 6 | 0.19 |
| Orthoptera | Gryllidae | *Gryllodes sp.* | 2 | 0.06 |
| Orthoptera | Gryllidae | *Gryllopsis sp.* | 2 | 0.06 |
| Orthoptera | Gryllidae | *Gryllus sp* | 1 | 0.03 |
| | **Subtotal** | | **13** | **0.41** |
| Orthoptera | Pyrgomorphidae | *Atractomorpha acutipennis* (Guer) | 4 | 0.12 |
| Orthoptera | Tridactylidae | *Tridactylus digitatus* (Late) | 1 | 0.03 |
| **Total** | | | **25** | 0.78 |
| **Grand Total** | | | **3202** | **100** |

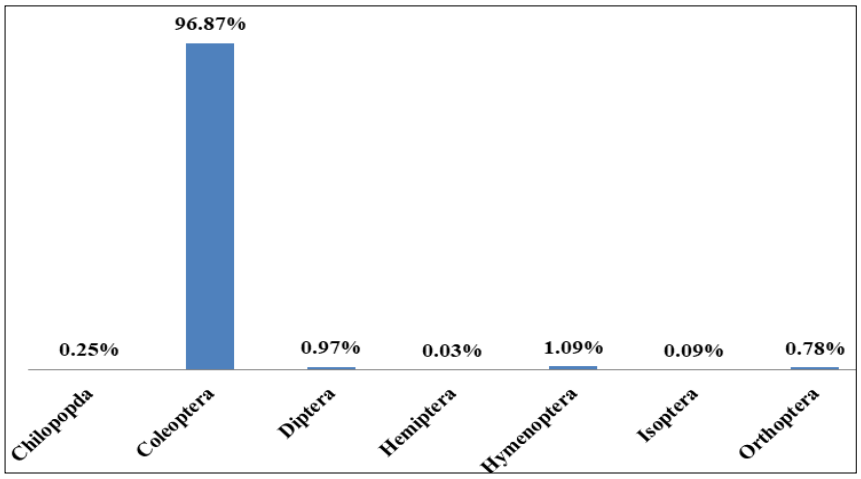


**Fig 4:** Bar-chart showing the Relative Abundance of Soil Arthropods Based on Order**.**

**Table 3:** Monthly Species Composition and Relative Abundance of soil arthropods

| Month | Order | Number Trapped | Relative abundance (%) |
|---|---|---|---|
| January | Coleoptera | 39 | 1.22 |
| | Hymenoptera | 5 | 0.16 |
| | **Total** | **44** | **1.37** |
| February | Coleoptera | 33 | 1.03 |
| | Hymenoptera | 3 | 0.09 |
| | **Total** | **36** | **1.12** |
| March | Chilopopda | 2 | 0.06 |
| | Coleoptera | 96 | 2.99 |
| | Hymenoptera | 8 | 0.25 |
| | Orthoptera | 2 | 0.06 |
| | **Total** | **106** | **3.31** |
| April | Chilopopda | 3 | 0.09 |
| | Coleoptera | 50 | 1.56 |
| | Hymenoptera | 1 | 0.03 |
| | Isoptera | 3 | 0.09 |
| | **Total** | **54** | **1.69** |
| May | Chilopopda | 1 | 0.03 |
| | Coleoptera | 369 | 11.52 |
| | Hymenoptera | 2 | 0.062 |
| | Orthoptera | 9 | 0.28 |
| | **Total** | **381** | **11.89** |
| June | Chilopopda | 1 | 0.03 |
| | Coleoptera | 2015 | 62.93 |
| | **Total** | **2016** | **62.96** |
| July | Chilopopda | 1 | 0.03 |
| | Coleoptera | 267 | 8.34 |
| | Diptera | 1 | 0.03 |
| | Hymenoptera | 1 | 0.03 |
| | Orthoptera | 9 | 0.28 |
| | **Total** | **279** | **8.71** |

**Table 4:** Monthly Species Composition and Relative Abundance

| Month | Order | Number Trapped | Relative abundance (%) |
|---|---|---|---|
| August | Coleoptera | 156 | 4.87 |
| | Hymenoptera | 13 | 0.41 |
| | Orthoptera | 1 | 0.03 |
| | **Total** | **170** | **5.31** |
| September | Coleoptera | 69 | 2.15 |
| | Hymenoptera | 2 | 0.06 |
| | Orthoptera | 2 | 0.06 |
| | **Total** | **73** | **2.28** |
| October | Coleoptera | 4 | 0.12 |
| | Diptera | 30 | 0.94 |
| | Orthoptera | 2 | 0.06 |
| | **Total** | **36** | **1.12** |
| November | Coleoptera | 5 | 0.16 |
| | Hemiptera | 1 | 0.03 |
| | **Total** | **6** | **0.19** |
| December | Coleoptera | 1 | 0.03 |
| | **Grand Total** | **3202** | **100** |

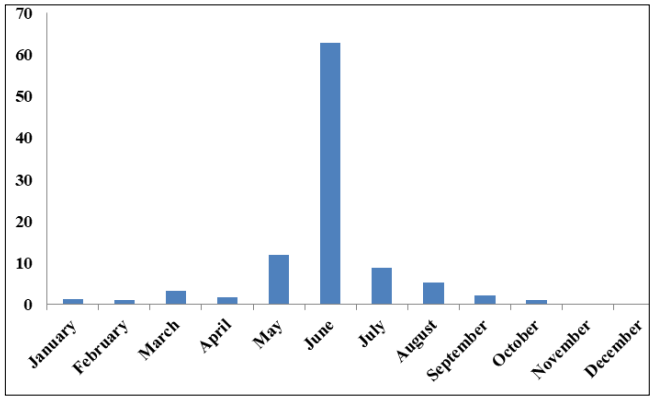


**Fig 5:** Bar-chart showing the Monthly Relative Abundance of Soil Arthropods.

## 4. Discussion of Results

### 4.1 Species Composition and Relative Abundance Based on Order

A total of 3202 individuals were sampled during the study (Table 1a and 1b). The order Coleoptera had the highest number of taxa 3099 with relative abundance of 96.78% (Table 1a), while, the Order Orthoptera had the least number of taxa 25 with relative abundance of 0.78% (Table 1b). This could be attributed to the study site because most Coleoptera are natural pest of agricultural crops.

The family Scarabaeidae had the highest taxa of 2067(64.55%). This could be attributed to their geographical distribution and population in the world; they are the largest family beetles in the world. Their high presence could also be attributed to their feeding. They feed primarily on live plant matter as adults and plant roots or rotting wood as larvae which was observed during the study. They were more trapped under the plant *Calotropis procera* (Linn) which could also provide shelter for them. The family Buprestidae, Acrididae, Lygaeidae and typhiidae had the least taxa of 1(0.03%).

In terms of species dominance, *Hister monitor* (Lewis) had the highest individuals of 901 with relative abundance of 28.14%, followed by *Copris sp.*, 879 individuals with relative abundance of 27.45% and *Gymnopleurus fulgidus* 719 individuals with relative abundance of 22.45% (Table 1a). *Chrysobotheris wilkinsoni, Aulocaryssu sp., Chlaenites splenditus, Dichaetochillus vagansi, Scarites gagatinus, Scarites (distichus) gagatinnus, Systolocranius sp., Tomochilus carrbonatus, Aulocophora vinula, Leptaulaca fassicallis, Platyxantha sp., Gasteroclissus rhomboidalis, Pycnodactylus alboglivus, Attagenus sp., Aphodius sp., Catantops haenlorrhoidalis, Dieuches spp, Compenetus vestitus, Elis sp., Acrida bicolor, Calephorus compressiconis, Catantops annulatus, Gryllus sp.*, and *Tridadactylus digitatus* all had the least number of taxa 1 species with relative abundance of 0.03% (Table 1a and 1b).

### 4.2 Monthly Species Composition and Relative Abundance

The month of June had the highest taxa of 2016 with relative abundance of 62.96%, followed by the month of May 381 with relative abundance of 11.89% (Table 2a). The Month of December had the least taxa of 1(0.03%) (Table 2b).The differences in soil arthropods across the sampling months could be attributed to favourable weather conditions (stable rainfall and moderate temperature), presence of different shrubs on the field and the degree of agricultural intensification. This agree with the work of Esenowo *et al.*, (2014) [8] were he reported that the differences in soil arthropods encountered in Anua and Ekpri Nsukara could be attributed to vegetation and the level of biotic interactions. This also agree with Yann *et al.*, (2005) [21], where he reported that the spatial surroundings of habitat patches may have a strong influence on local diversity and abundance of organisms.

## 5. Conclusion and Recommendation

From the research, it was observed that Coleopterans are the most abundant taxa in agricultural farmland. Coleopterans are majorly pest of agricultural crops. It was also observed that the months with presence of shrubs and favourable weather conditions had high relative abundance and species composition of soil arthropods; therefore, these two factors play a major role in soil arthropods conservation.

## 6. Acknowledgement

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