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Decomposition of Neem Leaf (*Azadirachta Indica* A.Jus) in Hafir Doka Reserve Forest-Sudan

By Maha Ali Abdelatif

Abstract- Litter Decomposition in forest ecosystems adds nutrients to plants, and represents a significant source of atmospheric CO_2. Despite its essential role in carbon and nutrient cycling, leaf litter decay in reserve forest ecosystems remains poorly studied. A completely randomized block design field experiment was conducted in Hafir Doka forest reserve, (latitudes "ٜ56 "15 015 and" ٜ26 "15 015 N. and longitude 32° 24" 23 "and 32° 13" 23 "E.). The aim of the study is to evaluate organic decomposition of neem leaf and the factors affecting it. One set of 36 litter bags each containing 20 gm. air dried neem leaf were buried 20 cm deep under the canopy of A*cacia tortilis* subsp. *spirocarpa* while another set of 36 bags were used as control, during the period November 2017- February 2018. Random samples of 14 bags were retrieved and taken to laboratory to extract their faunal contents. Soil and air temperature and soil moisture were measured during the sampling events. Decomposers fauna were extracted using Tullgern funnel. Data obtained were statistically analyzed using SPSS design at p= 0.05 and compared according to Pearson correlation coefficient. Results showed that nematodes (Aphasmida), mites (Acari: Oribatida) and Collembola (Insecta, *Entomobryidae*) were extracted as animal decomposers.

Keywords: *neem leaf, decomposition, collembola, mites, nematodes.*

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Abstract- Litter Decomposition in forest ecosystems adds nutrients to plants, and represents a significant source of atmospheric CO_2. Despite its essential role in carbon and nutrient cycling, leaf litter decay in reserve forest ecosystems remains poorly studied. A completely randomized block design field experiment was conducted in Hafir Doka forest reserve, (latitudes "ˇ56 "15 015 and"ˇ26 "15 015 N. and longitude 32º 24" 23ˇ" and 32º 13" 23 "E.). The aim of the study is to evaluate organic decomposition of neem leaf and the factors affecting it. One set of 36 litter bags each containing 20 gm. air dried neem leaf were buried 20 cm deep under the canopy of A*cacia tortilis* subsp. *spirocarpa* while another set of 36 bags were used as control, during the period November 2017- February 2018. Random samples of 14 bags were retrieved and taken to laboratory to extract their faunal contents. Soil and air temperature and soil moisture were measured during the sampling events. Decomposers fauna were extracted using Tullgern funnel. Data obtained were statistically analyzed using SPSS design at p= 0.05 and compared according to Pearson correlation coefficient. Results showed that nematodes (Aphasmida), mites (Acari: Oribatida) and Collembola (Insecta, *Entomobryidae*) were extracted as animal decomposers. The litter dry mass remaining within the A*cacia tortilis* subsp. *spirocarpa* site and the control was 51.4 and 48.5 %, respectively. Neem leaf decomposition rate showed a positive linear relation to the individual number of nematodes of correlation coefficient (8.85% to 3.55% in the control). Also, positive linear relations to the individual number of each of mites (6.25% vs. 1.25%) and Collembola (17.63% vs.3.17%) were observed. Temporal variation of decomposition rate correlated to soil temperature and moisture values indicated linear positive correlation to temperature during the initial months and negative ones during the final months, whereas moisture values were positively correlated to decomposition rate throughout the study period, (P= 0.05).

These results suggest that neem leaf litter decay in reserve forests may be affected by plant cover and climatic factors.

Keywords: neem leaf, decomposition, collembola, mites, nematodes.

I. Introduction

Litter decomposition is defined as the process through which organic material is broken down into small particles and mineralized. It occurs through three processes including comminution or fragmentation of detritus, leaching, and catabolism. The rate of decomposition is regulated by prevailing climatic conditions, chemical quality of detritus and decomposer organisms' diversity, (Aerts, 1997, Jones, 1998 & Malhi *et al.*, 2010).

Plant leaf is the main source of adding organic matter and nutrient to the soil compared to the other plant parts. Adding leaf litter to soil improve its physicochemical properties where increased soil moisture trigger the activity of decomposers, (Hossain *et al*,2011, Semwal *et al*, 2003).

The present study is aimed to study decomposition of neem leaf litter and factors affecting it in a reserve forest ecosystem.

II. Material and Methods

a) Study area

Hafir Doka Forest Reserve is located in the semi-dry climate, (latitudes 15^0 15 - 15^0 30 N and Longitudes 32^o 24 - 32 ° - 13 ° E) characterized by the short rainy season with high evaporation and low relative humidity values. Air temperature values show a significant increase in May and fall in July and October due to rainfall. Its soil is a mixture of sandy clay loam and dominated with *Acacia tortilis*.

b) Methods

Neem leaf litter bags were used according to Coleman, *et al*. (2004). 72 bags sized 15 cm X 12 cm X 2 mm diameter. They were filled with 20 gm. air dried neem leaf and then divided into two groups each of 36 bags. One group was buried in a 20 cm deep hole in *Acacia tortilis* Rhizosphere and the second group was used as a control in a completely randomized block design. Decomposition was measured as litter mass t loss obtained by retrieving 14 bags twice a month.

Factors affecting neem leaf decomposition were evaluated in terms of climatic and biological factors. Soil temperature and moisture values were recorded periodically with sampling events. Decomposers fauna in litter were extracted using Tullgern Funnel apparatus, counted and classified to the least possible taxonomic level.

c) Statistical analysis

Statistical Package for Social Sciences (SPSS), was used to analyze and compare data with LSD at 0.05. The Pearson Correlation Coefficient was used to determine the effect of climate factors on the organic decomposition of neem leaf using Statistical Software 8.

Author: Associate prof. National Centre for Research.
e-mail: mahaaali@hotmail.com

III. Results And Discussion

a) Decomposition of neem leaf litter

The rate monthly neem leaf decomposition was studied and compared between the two study sites. Results obtained shown in Fig. (1), indicated temporal variation of this rate. The rate of decomposition is noticed to be gradually decreasing in the two study sites throughput the study period and generally the decomposition proceeds is greater in the cultivated site than the barren one. The temporal variation of the decomposition could be ascribed to neem leaf composition and decomposability. Similar observation was previously recorded by *Loranger et al, (2002)* who illustrated that as decomposition proceeds; the decomposers usually utilize the soluble and degradable components like sugars, starches and proteins. On the other hand, during later stage, decomposition rate decreases due to the presence of recalcitrant i.e. lignin, cellulose, tannins and hemicelluloses

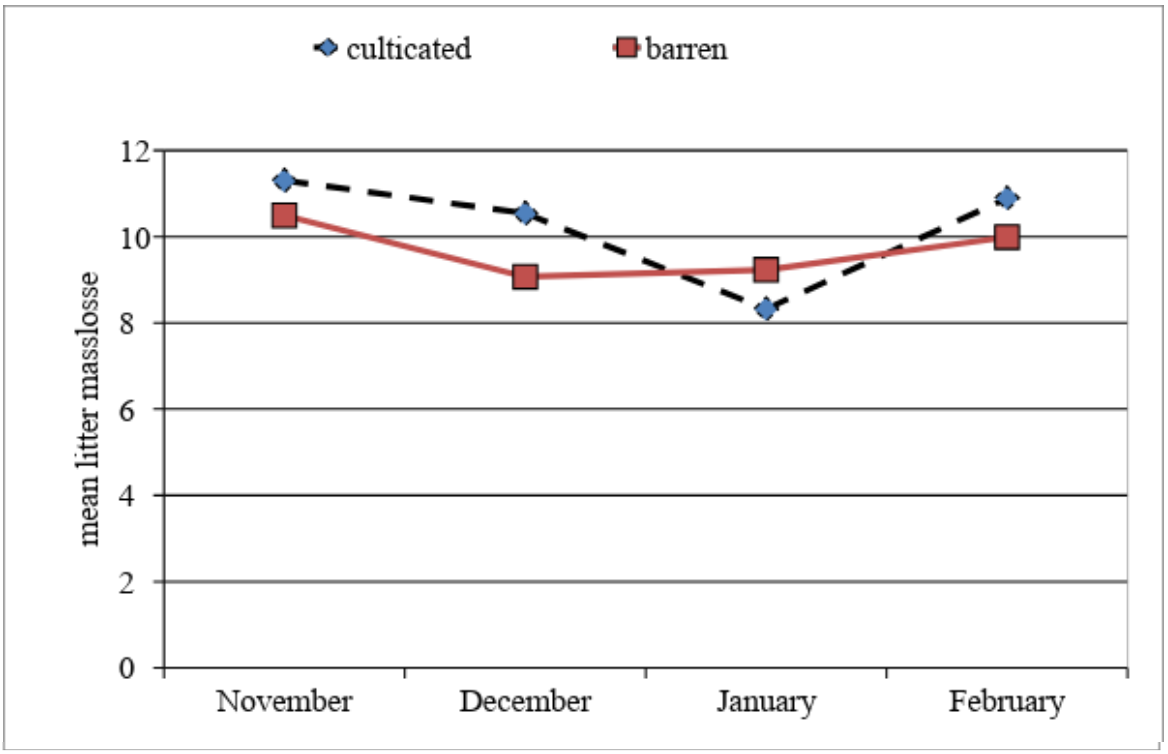

Fig. 1: Temporal variation of neem leaf decomposition in the two study sites

b) Factors affecting neem leaf decomposition

i. *Effect of soil temperature and moisture*

Measurement of temperature and humidity during the period of study shows that the temperature decreased during December and increased gradually in January and February. This pattern of variation applied to the two study sites, (Fig.2). This trend could be attributed to the prevalence of winter season which usually extend over four months started from October and temperature decreases gradually and increased again towards the end of the season.

Soil moisture was measured and compared between the two study sites. Results indicated that the cultivated site is wetter than the barren one except during December as shown in Fig. (3). Asaye, (2017), claimed that Acacia tortilis induced significant impact on soil moisture content.

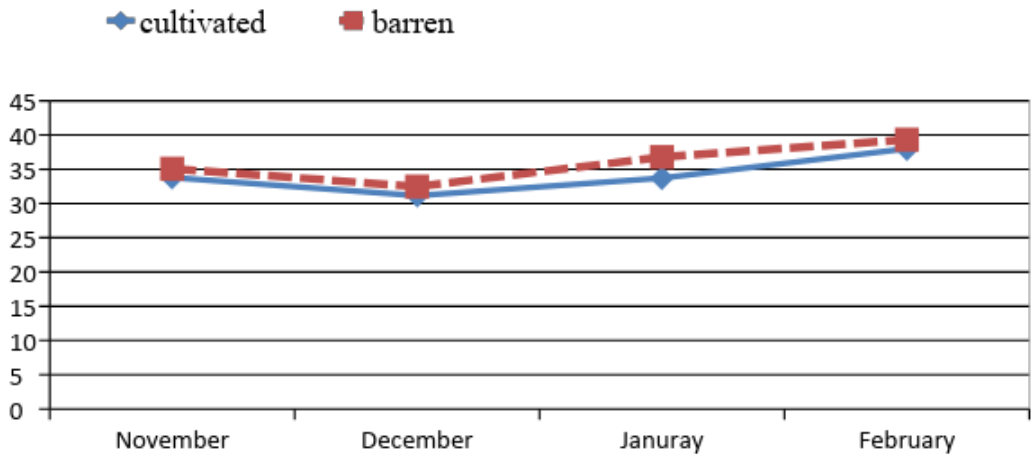

Fig. 2: Variation of soil temperature between the two study sites

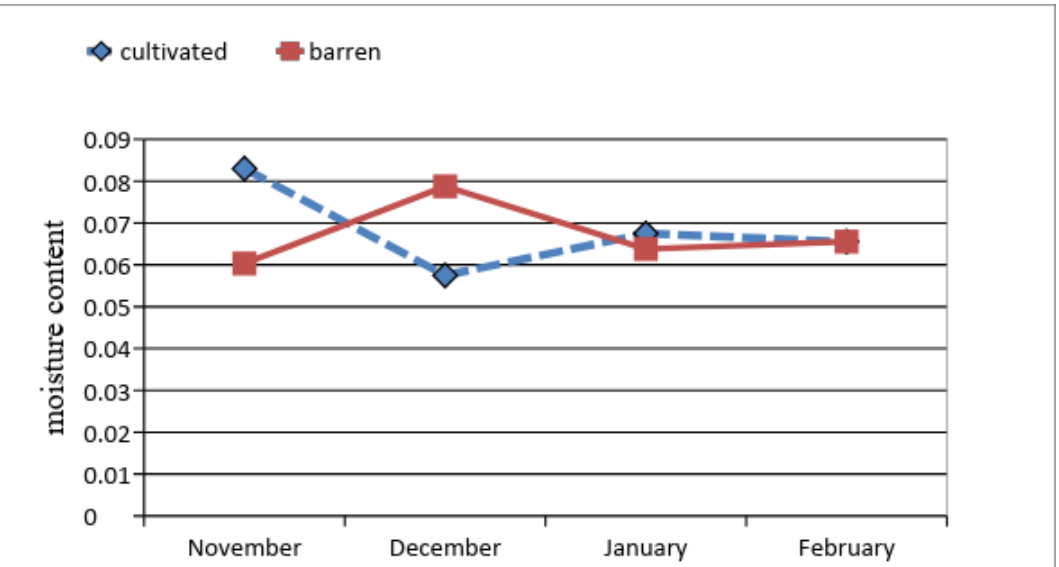

Fig. 3: Variation of soil moisture between the two study sites

Soil temperature and moisture content were correlated to the monthly mean weight loss of neem leaf. Results indicated that temperature was positively correlated to monthly mean weight loss of neem leaf in November in the two study sites, but negatively in the cultivated site in December and January. Monthly mean weight loss of neem leaf was negatively correlated to temperature in the barren site during February.

Monthly mean weight loss of neem leaf correlated to soil moisture content showed positive correlations throughout the study period in the two study sites as given in Table (1). Many studies have quantified the influence of temperature on the rate of litter decomposition and soil respiration. Moore (1986) carried out a laboratory study to relate the decomposition rates of hardwood and coniferous leaf litter with temperature and moisture. He concluded that decomposition rate was found to be a linear function of the temperature and moisture values.

Table 1: Pearson correlation coefficient for temperature, moisture and monthly mass weight loss of neem leaf litter

Month	Temperature		Moisture	
	cultivated	barren	cultivated	barren
November	0.483846	0.407567	0.083	0.060333
December	-0.48134	0.623474	0.0575	0.078778
January	-0.75574	0.508865	0.0675	0.063625
February	0.371474	-0.12142	0.073	0.065

ii. *Effect of animal decomposers*

Pearson Correlation Coefficient was applied to evaluate the role of animal decomposers on neem leaf decomposition. It was evident that positive correlation was observed between mass loss and animal decomposers individual mean number during November and December and a negative one during January and February except for mite which showed positive correlation during February, (Table 2)._Soil invertebrates are intimately linked to below ground process such as litter decomposition. Their effect depends largely on diversity of organisms and substrate quality. Such dependence showed temporal variations, Endlweberm *et al.*(2006)

Table 2: Pearson correlation coefficient for the effect of animal decomposers on the decomposition of neem leaf litter

Month	Animal Decomposer		
	Nematode	Mite	Collembola
November	0.036752	0.170496	0.352084
December	0.463251	0.36317	0.47343
January	-0.28316	-0.35968	-0.0705
February	-0.04559	0.142001	-0.04994

The effect of nematode on neem leaf litter decomposition was evaluated in term of mean mass loss, in both study sites. Results obtained showed that nematode mean number was correlated to neem leaf mean mass loss by 97.72 % in the cultivated site and 92.38 % in the barren site (Fig. 5 a & b respectively). According to Kimenju et al., (2004), nematodes may accelerate the decomposition of neem leaf and other organic substrate.

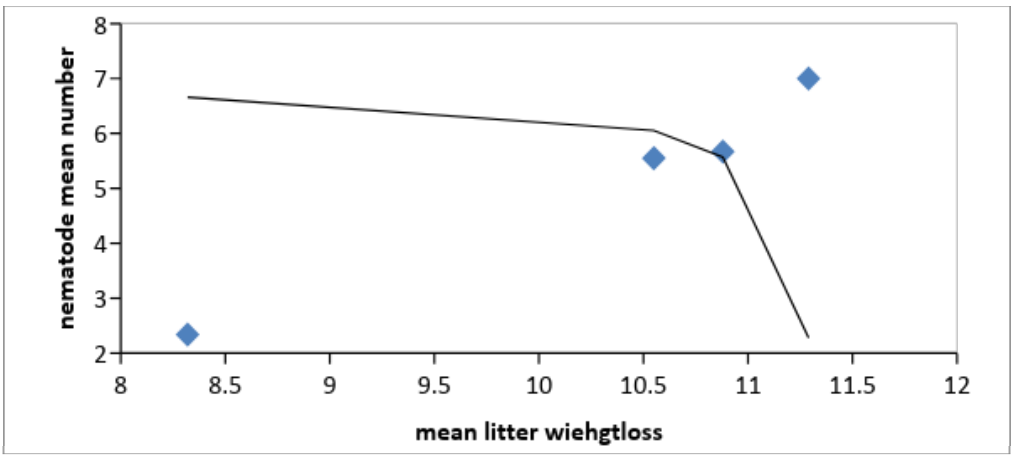

Fig. (4 a): Effect of nematode on decomposition neem leaf in the cultivated site

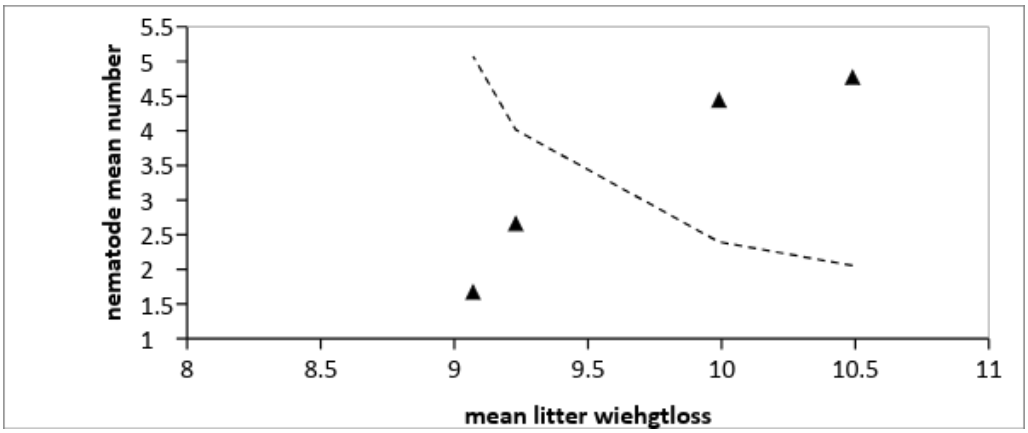

Fig. (4 b): Effect of nematode on decomposition neem leaf in the barren site

The effect of mite on neem leaf litter decomposition was evaluated in term of mean mass loss, in both study sites. Results obtained showed that the mean number of mite was correlated to neem leaf mean mass loss by 69.23 % in the cultivated site and 43. 30% in the barren site (Fig. 6 a & b respectively). Lussenhop, (1980), indicated that mite has significant role in decomposition.

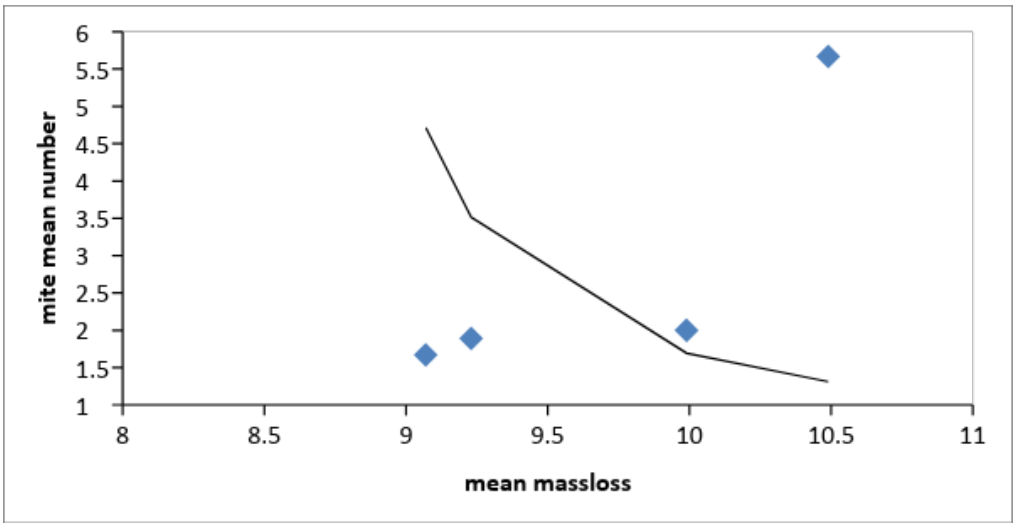

Fig. (5 a): Effect mite on decomposition neem leaf in the cultivated site

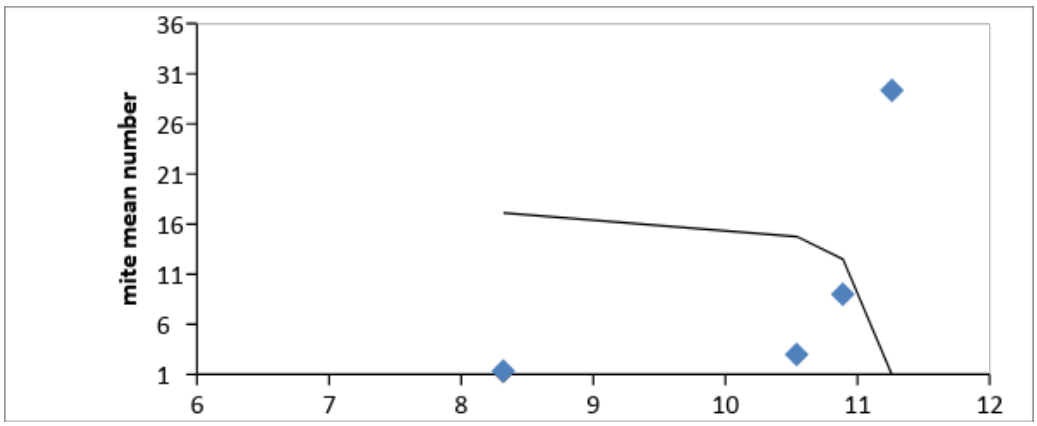

Fig. (5 b): Effect mite on decomposition neem leaf in the barren site

The effect of Collembola on neem leaf litter decomposition was evaluated in term of mean mass loss, in both study sites. Results obtained showed that collembolan mean number was correlated to neem leaf mean mass loss by 86.60% in the cultivated site and 37.34 % in the barren site (Fig. 7 a & b respectively). Due to their feeding activity; Collembola affect decomposition processes and the microstructure of the soil, Cragg and Bardgett, (2001).

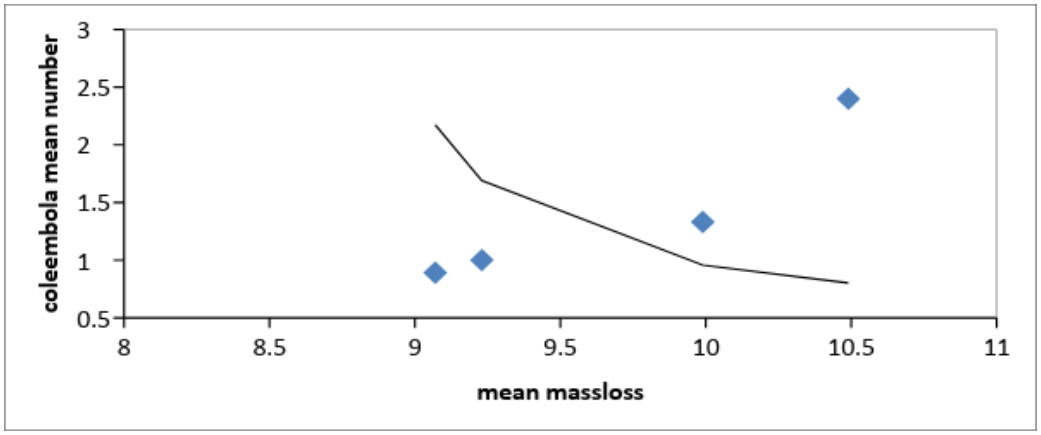

Fig. (6 a): Effect collembola on decomposition neem leaf in the cultivated site

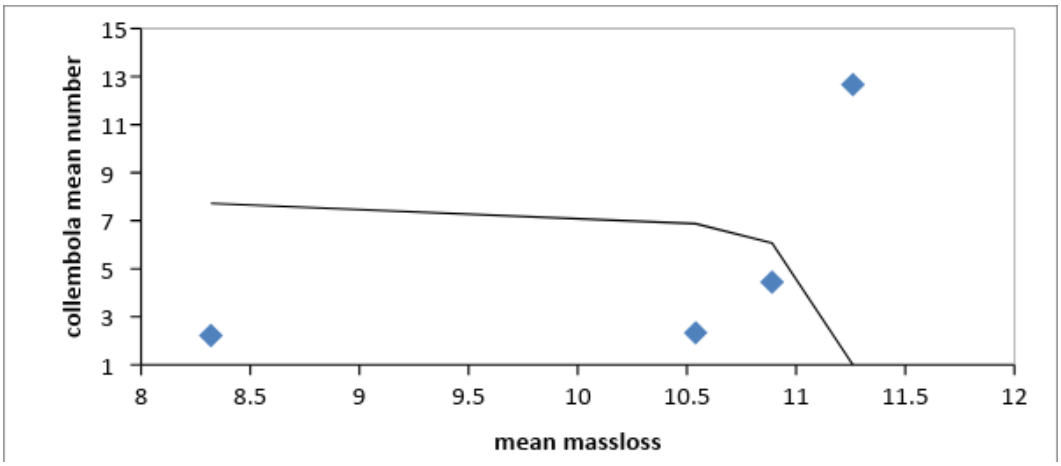

Fig. (6 b): Effect collembola on decomposition neem leaf in the barren site

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