Water and Environmental Sustainability
ISSN: 2710-3404
DOI: 10.52293/WES.2.4.2126
H o m e p a g e: https://www.journalwes.com/

Research paper

Soil Managing Techniques for Stable Agroecosystems in India

Kingsley Mohammed and Olagunju Achebe
Environmental Biology and Molecular Toxicology, University of Nigeria Nsukka

A R T I C l E I N F O

Keywords:
Managing Techniques
Soil Mesofauna
Edaphic Elements
Acari
Collembola

**Corresponding Author:*
Drkingsleymoh258@gmail.com

Received: 28 June, 2022
Accepted: 14 Sep, 2022
Available online: 10 Oct, 2022

A B S T R A C T

There is a critical demand for food need in the next fifty years is a massive challenge for the consistency of food production for global and local circumstances. Recent farming technologies might be improving fertility while they might be menacing farming ecosystems. This study presents the soil mesofauna importance and managing techniques to improve soil health. An adjusted tullegren funnel has accomplished the soil mesofauna extraction and analysis of edaphic elements like soil temperature, soil moisture, organic carbon, available nitrogen, and phosphate has been accomplished by standard lab techniques. The outcome demonstrated that soil mesofaunal communities are affected with some chosen elements by managing techniques like cropping, tilling, etc. that eventually help in keeping the health of the soil.

Introduction

The population of soil mesofaunal is a vital component of the biodiversity of numerous ecosystems and the populations need appropriate managing for constant land utilization. They contain mainly invertebrates like ants, earthworms, termites, amphipods, centipedes, millipedes, Collembola, Protura, and Acarina. The organisms are influenced by utilizing some managing techniques like cropping, tillage, pesticide utilization etc. Soil mesofauna is a key organism affecting the decay and biodegradation of organic remains, soil organic material dynamics, humification, and nutrient publish and soil physical features like bulk density, porosity, and water availability (Lee and Foster, 1991; Brussaard et al., 1993; Lavelle et al., 1992; TSBF, 1994; Tinzara and Tukahirwa, 1995; Black and Okwakol, 1999; Beare et al., 1997). The population of the soil faunal is an essential organism affecting decay and biodegradation of organic remains, soil organic material dynamics, humification, nutrient discharge, and soil biological features like bulk density, porosity, and water availability (Lee and Foster, 1991; Brussaard et al., 1993; Lavelle et al., 1992; TSBF, 1994; Tinzara and Tukahirwa, 1995; Beare et al., 1997). generally, soil faunal population analysis and redistribution of organic remains in the soil profile, improve their surface space for microbial movement. The next deposit of fecal pellets furthermore has significant ecological substances (Lavelle et al., 1992).

The soil fauna effect on soil structural features has been evaluated 4 for being the most suitable long-term soil quality index (Linden et al., 1994) yet in spite of the part in keeping of structure and the underground ecosystems function, the significance is usually ignored (Crossley et al., 1992) In India, confined analysis on soil mesofauna has been accomplished. Some of the well-investigated mesofaunas contain termites,

Collembola by most of the work focused on more or less natural environment.

Methodology

The investigation has been conducted at Aligarh Muslim University, A.M.U. Aligarh, U.P. (India) that the managing techniques involved in the investigation areas. There have been 2 areas for investigation. Area 1 that the managing techniques used and another area has been Area 2 by not considering any managing technique. In this investigation, soil samplings have been gathered from the depth of 0 to 5 cm by the assistance of a corer altered by Averbach and Crossly (1960). The soil samplings have been gathered bimonthly for a duration of 12 months. The soil mesofauna Extraction has been accomplished in a limited Tullegren-Funnel. The insects gathered have been maintained in seventy percent alcohol and recognized in a Steriozoom microscope. Investigation of edaphic elements like soil temperature, soil moisture, PH, organic carbon content, nitrate, and phosphate have been accomplished by standard lab techniques.

The temperature has been estimated with instantly putting the soil thermometer to the soil up to the essential depth, related humidity with a Dial Hydrometer, PH with an electrical PH meter, and soil water (water range) by Dowdeswell's (1959) approach. Organic carbon has been evaluated by the immediate titration technique as expressed by Walkey and Black (1934), nitrogen range (N) with Jackson (1966) procedure, and phosphorus range (P) by molybdenum blue test and Potash range (K) by Jackson (1966) approach.

Discussion and Results

Soil Categorization:

Chosen soil features outcomes under various managing techniques systems are demonstrated in Table 1.

Table. 1. Changing edaphic elements in each month at empirical areas

Months	Temperature of soil		Moisture of soil		PH		Organic carbon		Available Nitrogen		Phosphate	
	Area 1	Area 2	Area 1	Area 2	Area 1	Area 2	Area 1	Area 2	Area 1	Area 2	Area 1	Area 2
Jan	18	17	2.75	1.98	7.4	7.5	0.53	0.34	220	198	12.54	10.8
Feb	23	19	2.35	2.14	7.3	7.7	0.55	0.54	228	210	10.40	10.40
Mar	24	22	1.65	1.54	7.3	7.2	0.58	0.50	222	220	10.40	11.5
Apr	28	27	1.34	2.21	7.4	7.4	0.61	0.48	280	195	9.8	8.44
May	32	33	1.83	0.89	7.7	7.6	0.55	0.48	230	210	11.5	8.42
Jun	39	35	o.9	1.67	7.8	7.2	0.68	0.55	248	228	9.5	8.42
Jul	33	34	2.15	3.15	7.5	7.2	0.72	0.47	310	270	10.0	9.80
Aug	32.5	31	2.25	2.34	7.5	7.4	0.69	0.40	238	214	9.78	8.5
Sep	30	29	1.85	1.73	7.8	7.7	0.69	0.55	240	223	8.65	8.5
Oct	25.5	24	2.40	0.67	7.6	7.6	0.73	0.47	256	234	8.42	10.8
Nov	22	22	3.0	1.50	7.6	7.6	0.59	0.31	278	190	9.89	8.34
Dec	19	18.5	2.50	1.98	7.5	7.5	0.57	0.34	238	220	11.0	11.56

Soil PH classes in the empirical location have varied from 7.2 to 7.8. It has been maximum in areas that the cropping and tilling techniques were used (7.8), while the minimum at in another area (7.2). The maximum level of percent organic carbon has been recognized in the area where these managing techniques are used (0.72%), while the minimum on the other hand. Obtainable nitrogen has been the maximum at Area 1 (310 ppm) while also the minimum in Area 2 (190 ppm). The level of phosphorous has been minimum in Area 2 (8.34 ppm) with the maximum level being recognized in the Area 1 (12.54 ppm).

Population of the soil mesofaunal

Soil mesofaunal variety happening in the various empirical areas investigated is demonstrated in Table 2. The variety of soil mesofauna in the empirical site has been so prosperous that the managing techniques used (Area 1) as compared to another area (Area 2).

Table. 2. Population fluctuations importance of different soil mesofaunal classes as defined by ANOVA examination in empirical area at the depth of 0 to 5 cm.

Source of Variation	***SS***	***df***	***MS***	***F***	***P-value***	***F crit***
Between Groups	245.4167	3	81.80556	21.11111	1.27E-08	2.816466
Within Groups	170.5	44	3.875			
Total	415.9167	47				

Generally, the mesofaunal population has been the most productive in terms of both number and biomass at Area 1. Soil mesofaunal population has performed the study at a specified time for the estimation of the relation of abiotic elements. The samplings gathered from the areas generated insects and mites under the mesofaunal population. The whole number of insects and mites demonstrates the irregular oscillation in the sampling time.

The whole mesofaunal population consist of Pterygote, Apterygote and Acari. The pterygote population from both the areas is composed of Diptera, Hymenoptera, Isoptera, Coleoptera, Collembola, Protura, and Acarina. There is a positive or negative relation by the edaphic elements. In general, Diptera has been the more productive of the mesofauna group including nearly 45percent of the whole observed by Coleoptera (39 percent), Isoptera (6 percent), Hymenoptera (5 percent), Collembola (3percent), Protura (2 percent) and Acarina (1 percent). The other mesofaunal classes, which included Hemiptera, and Dictyoptera, everyone included <1 percent of the whole mesofauna documented (Fig. 1). Tripathi G. at al (2007) noted that the soil mesofauna and fluctuation population in cast composition by seasons differ from kind to kind. The Apterygote and Acari population has been completely changing.

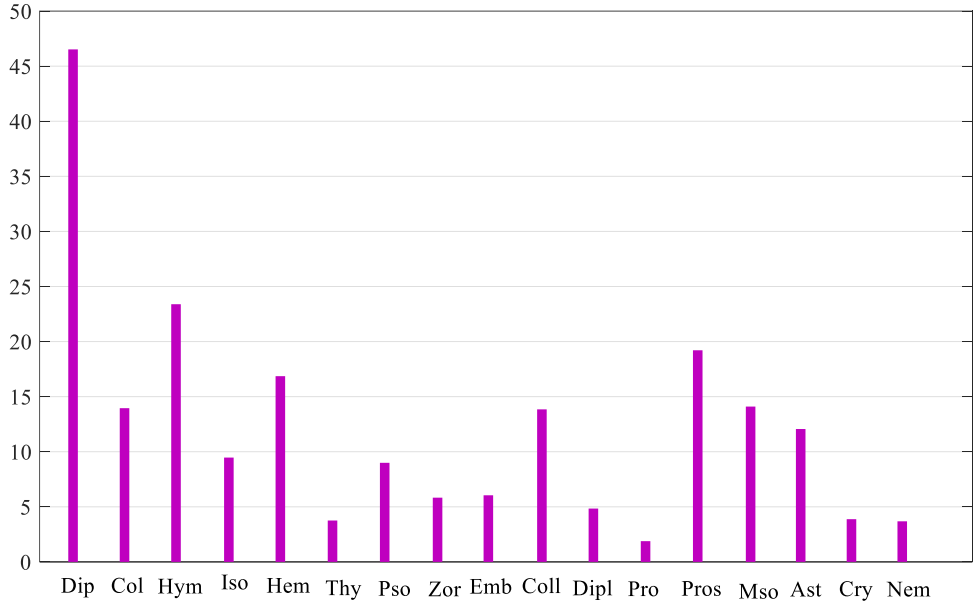

Fig. 1. Predominant demands of soil Mesofauna in practical areas from the depth of 0 to 5cm

While we have compared the population by the edaphic elements, it evolves obvious that by the soil temperature and moisture has been appropriate for the mesofaunal population still they haven't gathered in large numbers. The reasoning we have attempted to study. The population soil mesofauna from the practical areas all has been statistically demonstrated to fall in line by the obedience of the earlier investigators. The lower and higher population are interrelated by the edaphic features. The moisture of the soil has a positive correlation with the soil mesofauna population. The Collembola, Diplura, and Acari populations have been average in Area 1. while the soil moisture has been highest in January; the Collembola population has been at the maximum.

Our statements are in agreement by the discoveries of Block W. (1981), Verhoef, H.A. and Van Sleen A.J. (1985), coulson S.J. et al. (1995), Huhta Veikko and Hanninen Sanna – Maria (2001) and Lindbery N. and Bengtsson (2005). Now the next significant edaphic element is soil PH changed from 7.4-7.8. It included a little or immediate impact on the soil microarthropods population. Our outcomes are advocated by the findings of Bath (1980), which noted that acidification includes a significant impact on the sub-soil insects. Now it is a verified truth which phosphate that is in very low amounts contains a positive correlation by some insects. It appears that there has been a slight divergence among the phosphate component of soil.

There is negligible connection among the population of the soil faunal and the phosphate excluding in Coleoptera and Acari. Choudhoury and Roy (1972) and our other investigations (Parwez H. and Sharma N. 2014(a)2014(b),2014(c),2015,2017(a),201 (b) and 2019) asist the results that they seen either positive/negative relation of collembolan population by phosphate range.The available nitrogen amount that eventually alters to nitrate by the procedure of Nitrification changed among 226.8 ppm-256.2 ppm.

There has been a growth in the nitrogen range of the soil in showery season since by the

reduction in temperature in showery season generated a growth in the Collembolan population; with the analysis of dead arthropods, exclave with the soil bacteria eventually improved the soil Nitrogen range. Belfield (1970) has been noted excreta of arthropods untouched with the bacteria in dry season while exposed to quick bacterial movement generates population growth by growing in nitrogen range. Finally, we could conclude that managing techniques like Cropping, Tilling etc. improve the mesofaunal population that the soil productivity growth.

Conflict of interest

The authors declare that they have no conflict of interest.

References

Averbach, S.I. Crosslay, D.A; (1960). A sampling device for soil microarthropods. Acarologia, 2; 279-287

Beare, M.H., Reddy, M.V., Tian, G. and Scrivasta, S.C. (1997). Agricultural intensification, soil biodiversity and agroecosystem function in the tropics: the role of decomposer biota. Applied Soil Ecology, 6: 87-108.

Beare, M.H., Reddy, M.V., Tian, G. and Scrivasta, S.C. (1997). Agricultural intensification, soil biodiversity and agroecosystem function in the tropics: the role of decomposer biota. Applied Soil Ecology, 6: 87-108.

Black, H.I.J. and Okwakol, M.J.N. (1999). Agricultural intensification, soil biodiversity and agroecosystem function in the tropics: the role of decomposer biota. Applied Soil Ecology, 6: 37-53.

Block W. (1981). Low temperature effects on microarthropods. *Journal of thermal biology, 6(4); 215-218.*

Brussaard, L.,Hauser, S. and Tian, G. (1993). Soil fauna activity in relation to the sustainability of agricultural systems in the humid tropics. In: Mulongoy, K. and Merckx, R. (eds), Soil Organic Matter Dynamics and Sustainability of Tropical Agriculture, pp. 455-460. WileySayce, New York.

Brussaard, L.,Hauser, S. and Tian, G. (1993). Soil fauna activity in relation to the sustainability of agricultural systems in the humid tropics. In: Mulongoy, K. and Merckx, R. (eds), Soil Organic Matter Dynamics and Sustainability of Tropical Agriculture, pp. 455-460. WileySayce, New York.

Choudhuri D.K. and Roy S. (1972). An ecological study on Collembola of West Bengal, India,*Ric. Indian Museum India*, 66(1-4); 81-101.

Coulson S.J., Hodkinson I.D., Block W., Webb N.R. and Worland M.R. (1995). Low summer temperatures: a potential mortality factor for high arctic soil microarthropods. *Journal of Insect Physiology*, 41(9): 783-792.

Crossley, D.A., Mueller, B.R. and Perdue, J.C. (1999). Biodiversity of microarthropod in agricultural soils: relations to processes. Agriculture, Ecosystems Environment, 40: 37-46.

Dowdeswell W.H. (1959). Practical Animal Ecology. *Methuen and Co. Ltd.*

Hunta Veikko and Hanninen Sanna – Maria (2001). Effect of temperature and moisture fluctuations on an experimental soil microarthropods community. *Pedobiologia; 45(3); 279-286.*

Jackson M.L. (1966) "soil chemical analysis" Prentice – Hall Inc Englswod Cliffs, New Jersey.

Lavelle, P., Spain, A.V., Blanchart, E., Martin, A and Martin, P.S.(1992). Impact of soil fauna on the properties of soils in the humid tropics. In: Sanchez, P.A and Lal, R. (eds), Myths and Science of soils in the tropics. Soil Science Society of America, Special publication. No. 29, Madison, USA, pp. 157-185.

Lavelle, P., Spain, A.V., Blanchart, E., Martin, A and Martin, P.S. (1992). Impact of soil fauna on the properties of soils in the humid tropics. In: Sanchez, P.A and Lal, R. (eds), Myths and Science of soils in the tropics. Soil Science Society of America, Special publication. No. 29, Madison, USA, pp. 157-185.

Lee, K.E., and Foster, R.C., (1991). Soil fauna and structure. Australian Journal of Soil Research, 9: 754-760.

Lindberg N. and Bengtsson J. (2005). Population responses of oribatid mites and collembolans after a drought disturbance.*Applied Soil Ecology, 28; 163-174.*

Linden, D.R., Hendrix, P.F., Coleman, D.C. and van Vliet, P.C.J. (1994). Faunal indicators of soil quality. In: Doran, J.W., Coleman, D.C., Bezdicek, D.F. and Stewart, B.A. (eds). Defining Soil Quality for a Sustainable Environment. SSSA Special Publication, No. 35, pp. 3-22

Parwez H. and Sharma N. (2014) Effect of Edaphic Factors on the population density of soil micro arthropods. *Journal of Agroecology and natural Resource Management. Vol-1;187-190*

Parwez H. and Sharma N. (2014) Circannual Variation and Interrelationship of Edaphic Factors With the Soil Micro Arthropods in Agro Forestry Habitats. *International journal of scientific research. Vol-3;25-27*

Parwez H. and Sharma N. (2014) Comparative Assessment on the Effectiveness of Rainfall on Soil Microarthropods Population .*International journal of science and research. Vol-3;2775-2779*

Parwez H. and Sharma N. (2014) Effect of horticulture practices on the population of soil microarthropods. *International Journal of Basic and Applied Biology, Vol-2(1);40-43*

Sharma N. and Parwez H. (2017) Seasonal Dynamics and Land use Effect on Soil Microarthropod Communities in the Northern Indian State of Uttar Pradesh (India). *International Journal of Applied Agricultural Research, Soil Management Practices for Sustainable Agro-ecosystems in India* 597

Sharma N. and Parwez H. (2017) Population density and diversity of Soil mites (Order: Acarina) in agroforestry habitat: Relationship to Soil temperature and Soil moisture. *International Journal of Applied Environmental Sciences, Research India Publication*s, *Vol-12;1449-1460*

Sharma N. and Parwez H. (2019).Effect of management practices(Pesticide application) on soil mesofaunal population. *Journal of Agroecology and natural resources management(JANRM),Vol 6;144-148*

Tinzara, W. and Tukahirwa, E.M. (1995). The effects of soil macrofauna on soil properties in a banana cropping system, Masaka District, Uganda. TSBF Afnet V Report. Nairobi, Kenya. pp. 23.

Tinzara, W. and Tukahirwa, E.M. (1995). The effects of soil macrofauna on soil properties in a banana cropping system, Masaka District, Uganda. TSBF Afnet V Report. Nairobi, Kenya. pp. 23.

Tripathi, G., R. Kumari and B.M. Sharma(2007): Mesofaunal biodiversity and its importance in Thar Desert. J. Environ. Biol., 28, 503-515.

TSBF (1994). Tropical Soil Biology and Fertility Programme. Annual Report, pp 52, Nairobi, Kenya. 52p

Verhoef H.A. and Van Selm A.J. (1983). Distribution and population dynamics of Collembola in relation to soil moisture.*Ecography, 6 (4); 387.*

Walkley A. and Black I.A. (1934). An examination of the degtjareff method for determining soil organic matter and a proposed modification of the chromatic acid titration method. *Soil Sci., 37: 29-38.*