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The Study of Ammonium Excretion in Agricultural Soil Microarthropods [Collembola-Spring tails]] in Grassland Area Of Roorkee(Haridwar) in Uttarakhand State.

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Abstract:-

Collembola,an important group of soil microarthropods are usually associated with moist habitats, these are considered to be good model organisms for determining ecological toxicity and are used as non-target bio-indicators in environmental assessments. The susceptibility of these micro-arthropods to different edaphic perturbations is remarkable. One significant element leading to the degradation of soil quality in modern times is the indiscriminate use of insecticides in agricultural fields. Even while using insecticides in agriculture might be profitable, the harmful consequences of these chemicals affect not just the targeted pests that are intended to harm but also a variety of important soil fauna. The adoption of sustainable farming methods is the key to cultivating and conserving a diversified soil community, which plays critical roles in supplying functions and services throughout ecosystems. The goal of this review is to thoroughly explain the negative effects of insecticides on these vital micro-arthropods. An examination of the effects of several insecticides on various Collembola species reveals that collembola is among one of the most vulnerable soil fauna to insecticide contamination.

Keywords:- Collembola , Microarthropods, Insecticides, Ecosystem.

1.Introduction :- Breakdown of dead organic matter in soil ecosystems is mainly a result of the activity of fungi and bacteria, but soil invertebrates can influence the functioning of these primary decomposers as a result of feeding activities [Berg et al.2001]. By their consumption and metabolism of fungal biomass or other food items,soil microbes excrete inorganic nitrogen,

which ini turn can be readily as assimilated by plants, or leach to deeper soil layers. The presence of collembola in soil micro cosms has been shown to increase soil pore water concentrations of ammonium, suggesting that ammonium is excreted by collembola.

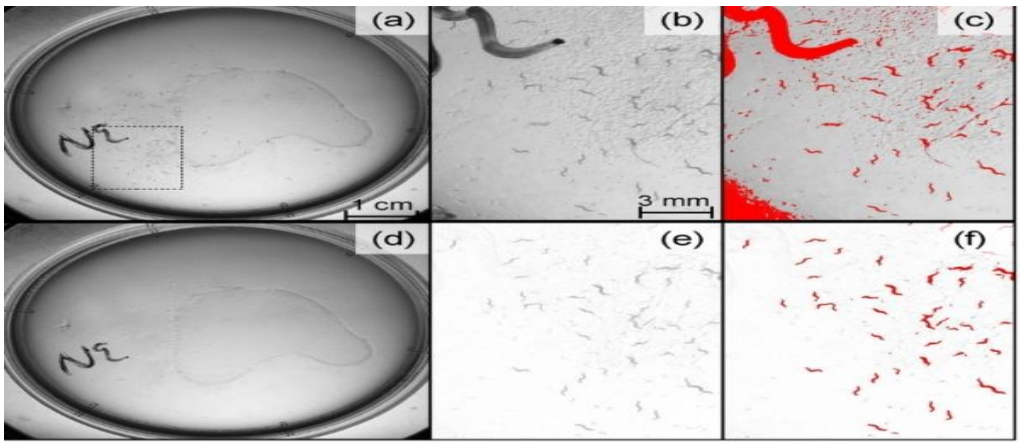
Freshwater insects soil dwelling insect larvae and other hygrophilic terrestrial arthropods such as isopods,use ammonium as the principal nitrogenous excretory product [Hadley 1994]. Ammonium is relatively toxic to the animals themselves. However, these organisms constantly absorb water from their environment, and therefore produce copious quantities of urine with ammonium is non- toxic concentrations [Hadley- 1994]. The same inter- relationship between organisms and soil water exits in Collembola. From a physiological viewpoint it is therefore likely that Collembola also use ammonium as the most important nitrogenous excretion product.

The N budgets of the Collembolan Tomocerus vulgaris and estimated indirectly that about 46% of injested N was eccreted via urine. In ecological studies, researchers have thus applied an indirect estimation of nitrogenous excretion by Collembola and other arthropods, based on estimates of respiration rate, C- fluxes, and C:N ratios of the organisms and their assumed food source . To increase the understanding of soil animal functioning in soil ecosystems, there is a need to develop techniques to determine more precisely the nitrogen mineralization by soil micro- arthropods of immediate importance for plant growth. In the present study we describe

a simple method for the director quantification of ammonium excretion in Collembola and other micro-arthropods.

2. Materials and Methods :-

The area selected for the study was agricultural fields at Haridwar (Roorkee). The extraction of the soil mesofauna is basedon the behavioural response by the animals which display downward movement after being subjected to the appropriate stimulus such as heat, illumination or desiccation. We used the Tullgren funnel for the extraction of insects from the soil samples.



Greenway Of Salempur Rajputana Area in Roorkee

Grassland Area of Salempur Rajputana

- **MICROARTHROPODS** - Seven species of Collembola and a predaceous mite [Mesostigmata] for studied Tomocerus vulgaris, Xenylla grisea, and Hypogastrura arctica. Folsomia candida, & Protaphorura armata, Sinella curviseta and the mite Hypoaspis aculeifer. All test species were collected from permanent cultures maintained at 20°C at our laboratory. Microarthropods of approximately the same size and age were collected at random from the culture and kept at 20°C on a moist layer of plaster of paris/charcoal covering the bottom of pateri-dishes. The Microarthropods were starved for 2 days under these conditions prior to the experiments.
- **CALIBRATION AND VALIDATION OF THE METHOD:-** For the development and validation of the method, three experiments were initially conducted with F. candida.Firstly, it was necessary to show that excreted NH4+ trapped In the moist quartz sand would not be converted to NO2- or NO3- or lost in other ways in the system used. To this end, test chambers containing to F. candida were placed at 20°C for 5 days, after which all animals were removed. The chambers were then kept for further 1,4 or 6 days, replicates were sampled at each interval. Next it was necessary to decide on a suitable excretion period and the number of test specimens added to each chamber to obtain a detectable concentration of NH4+. F candida lies within the range of 0.13- 0.28ug $NH^{4}+$ mg-1 dry weight, with a mean of 0.21ug. The amount of

ammonium excreted into the test chambers by the Collembola increased significantly over time, but even after 2 days there was enough ammonium present for reliable detection. The amount of ammonium excreted per animal dry weight did not differ significantly with increasing density of animals. The chambers were left empty indicating that microbial conversion of ammonium or ammonia evaporation did not take place. Ammonium was thus effectively trapped by the quartz sand and the weak acidic buffer solutions, and no notification occurred in the test chambers.

This demonstrates that the method is valid and can probably be adjusted to any type of microarthopod that can be cultured in the laboratory, test chamber, and kept at 20°C for 2, 4,7 or 9 days using seven replicates for each test period. Control chambers containing no animals were prepared as well, and left for 9 days before quantification of NH_4^+ - N. Effect of animal density was investigated by using seven replicate test chambers with 0,1,2,4, 7 or 10 specimens of F. candida. The chambers were placed at 20 degree centigrade for 5 days before analysis of NH_4^+ - N.

- **THE EFFECT OF TEMPERATURE:-**

Ammonium excretion of micro arthropods was determined at 5,10,15 and 20°C after a 2 days acclimation period in Petri dishes at these respective temperatures. For this,10 F.candida, 15 T. vulgaris, 10 Protaphorura armata, 10 Sinella curviseta, 10 Xenylla grisea, 10 Hypogastrura arctica, 10 Hypoaspis aculeifer were placed separately in test chambers. Seven replicates were used for each treatment. In addition, seven control chambers containing no animals were placed at the respective temperatures. All test chambers were kept under these conditions for two days, before extraction as described above.

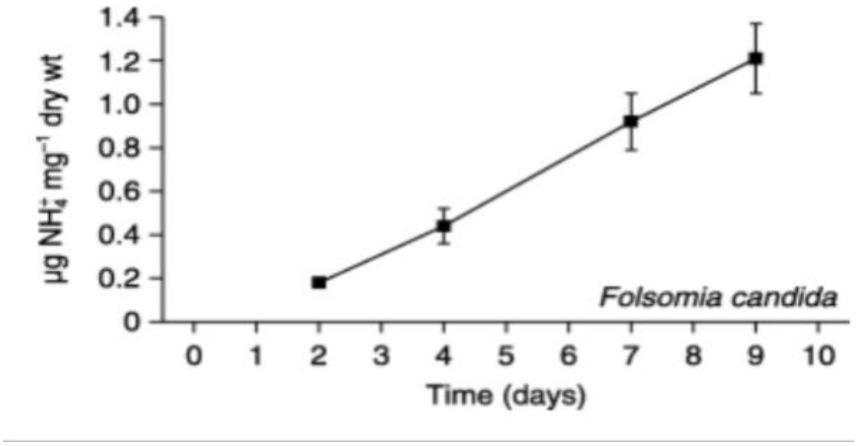
- **RESULTS AND DISCUSSION :-**

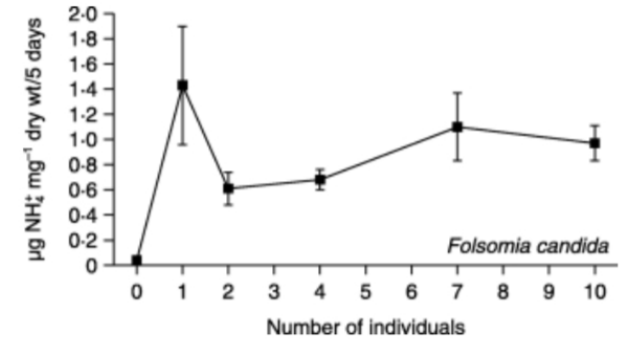
During six months of Collembolan collection, we have recorded 7 species at Roorkee regions different site at Salempur and Sonali Park areas.

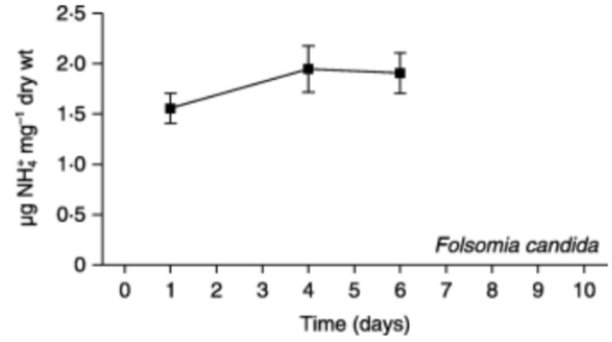
Table1.- Total collection of Collembola in Salempur Rajputana Area of Roorkee Regions :-

Species	Months	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total
Tomocerus vulgaris	**Sample**	48	50	35	30	39	45	25	272
Xenylla grisea	**Sample**	80	50	45	12	12	25	18	232
Hypogastrura arctica	**Sample**	20	15	10	10	20	08	04	87
Folsomia candida	**Sample**	32	40	20	18	10	15	10	145
Protaphorura armata	**Sample**	10	15	25	15	07	09	06	87
Sinella curviseta	**Sample**	48	30	24	28	25	18	15	118
Hypoaspis aculeifer	**Sample**	35	20	15	18	32	25	12	157
								Total	1098

Comparisons between these experiments show that the daily excretion rate in ammonium excretion seems to be the most important pathway in the N - metabolism of Collembola. However,uric acid is known also to be excreted during moulting by renewal of midgut epithelium (Humbert 1978) and wire via urine produced by the labial nephridia present in some Collembola (Verhoef et al. 1983). It is therefore possible that our measurements of ammonium used as a quantification of total N- excretion by Collembola may be somewhat underestimated. It should be noted that test animals were starved for 2 days before measurements ensuring that detected NH4 - N originated from urine. If fed animals were studied the method would also capture ammonium excreted via faeces.







All the tested species had basic excretion rates with in the same order of magnitude. These results are largely in keeping with reported estimates of inorganic N- excretion in soil micro arthropos.

In conclusion, we suggested that the described method could be used for more precise estimations of the N- excretion of both feeding and starving microarthropods with wide applications for studies of microarthropod function in soil ecosystems.

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