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LABORATORY OBSERVATIONS ON C/N RATIO OF SOIL BY EARTHWORM INOCULATION

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Abstract–Earthworms of soil sub-system gradually affect the C/N ratio and reduce it to make it available to plant. In order to have an insight of extent of reduction of C/N ratio only by earthworms, experiments were designed with sterilized soil and a locally available common earthworm *Perionyx sansibaricus* (Michaelsen). The C/N ratio of sterilized soil was examined and after inoculation with definite biomass the C/N ratio was estimated on 7th, 15th and 25th day after inoculation. The final reduction of C/N ratio was recorded to be 28.96%. This aspect of lowering of C/N ratio may be useful in the decomposition process of the organic matter.

INTRODUCTION

Though mankind, since the time of Aristotle, has valued the importance of earthworm, it is Charles Darwin, 1881, the first man to publish research paper on earthworm. Darwin concluded that these animals have played important role in the history of world. He observed that all fertile soil had gone through the gut of the earthworms leading to the fact that earthworms enhance fertility. The experiments on earthworms have proved that they basically change the carbon (C) and nitrogen (N) content of soil and thereby alter the C/N ratio. The increase in the amount of nitrogen in soil by earthworm has been attributed to decay of bodies of dead worms and due to nephridial excretion and mucus secretion. Of the nitrogen added to soil from the decomposed worm tissue, 25% is in form of nitrate, 45% as ammonia, about 3% as soluble organic compounds and 27% is unaccounted which probably consists of undecomposed remains of setae and cuticle and microbial proteins (Satchell, 1967). Earthworms feeding on litter gradually lower its C : N ratio as they break the material down during their metabolism. Thus, lowering is achieved mainly by combustion of carbon during respiration. Plants cannot assimilate mineral nitrogen unless the ratio of carbon to nitrogen (C:N) is about 20:1 or less, which is much higher in freshly fallen litter (Edwards and Lofty, 1977). The present work has been carried out in laboratory to have an insight on change in the amount of C and N and C/N ratio by earthworm *Perionyx sansibaricus* a dominant species in organically rich sites specially garbage dumping areas and compost rich areas.

MATERIALS AND METHODS

Perionyx sansibaricus was collected from a wet organically rich garbage site following Dash and Patra (1977) from Ranchi University campus and acclimatized to the lab conditions for a period of one month before the onset of the experiment.

Soil used for the experiment was first amended to suit the earthworms during culture and then sterilized to remove other agents of decomposition and breakdown of C and N. Sterilization of soil was done in Centre for Biotechnology, Marwari College, Ranchi. Amendment included equal proportions of soil, dry cow dung and saw dust (soaked in water for a period of two weeks).

Six culture pots, each containing 1 kg of sterilized soil were set in the lab in September, 2000, of which 3 were designated as control without worms and to each of the rest 10 adult worms were added. The cultures were maintained at 22°±3°C room temperature and 20 ± 3g% soil moisture. Total organic matter, organic carbon and nitrogen were estimated from soil in both control and experimental pots after 7th, 15th and 25th days. Chemical analysis like organic matter, organic carbon and total nitrogen were made in the laboratory as per Mishra (1968).

Observation

The amended soil after sterilization showed 7.413 ±

0.02% of organic matter, 4.3 ± 0.05% of total carbon and 0.13 ± 0.02% total nitrogen. After the inoculation with earthworms the total organic matter was found to be 9.656 ± 0.035, 11.21 ± 0.026 and 12.936 ± 0.011 showing an increase of 30.25%, 51.22% and 74.50% over the initial value on 7th, 15th and 25th day of estimation. The changes were statistically significant (P>0.01). A change of 30.46% (5.61± 0.03), 51.39% (6.51± 0.04) and 74.88% (7.52±0.10) over initial value of carbon content was observed at the same intervals. The differences between the control (initial) and the inoculated soil were statistically significant (P > 0.01).

On 7th day the change in total nitrogen content was statistically significant (P > 0.05) and was recorded to increase by 46.15% (0.19 ± 0.07) while on 15th and 25th day the statistically significance level (P>0.05) was more than that of 7th day change and the increase was of the order of 84.61% (0.24 ± 0.03) and 146.15% (0.32 ± 0.03). Variation in total organic matter, total carbon, nitrogen and C/N ratio has been presented in Figs. 1 and 2. The C/N ratio was initially 33.08 which changed as 29.52, 27.12 and 23.50 on 7th, 15th and 25th days showing a decrease of 10.76%, 18.02% and 28.96% respectively. The control soil however showed a decrease of 2.2%, 3.4% and 4.8% respectively.

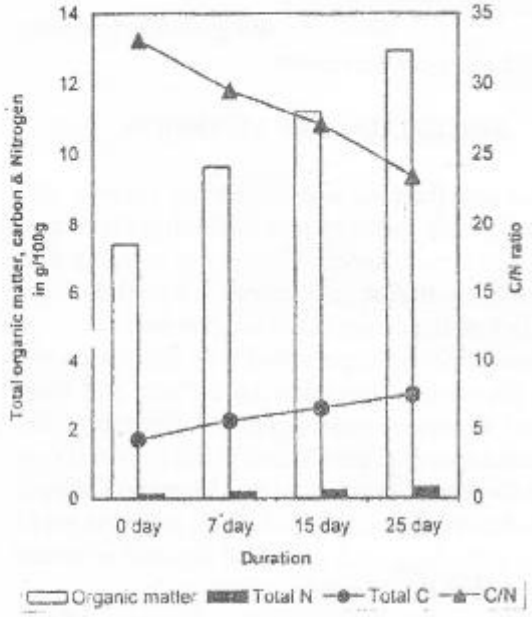

Fig. 1. Variation in total organic matter, carbon, nitrogen and C/N ratio in amended experimental soil

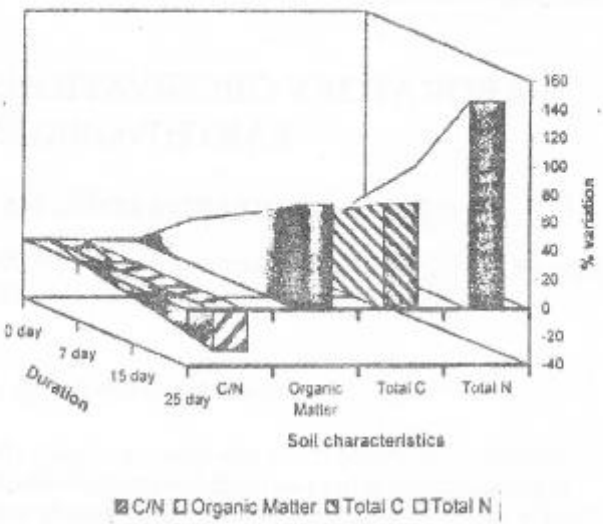

Fig. 2. Percentage variation in total organic matter, carbon, nitrogen and C/N ratio.

The details of changes in total organic matter, total carbon content and total nitrogen and corresponding changes on 7th, 15th and 25th days have been presented in Table 1.

DISCUSSION

The C/N ratio is an important factor affecting fertility of soil which is considerably altered by earthworms. Senapati *et al.*, (1980) demonstrated that *Octochaetona surensis* (Michaelsen), a dominant earthworm in pasture soil of western Orissa decreased the C/N ratio considerably in laboratory experiments on 7th and 25th days of estimation. A

Table 1. Variation in total carbon, total organic matter, total nitrogen and C/N ratio in amended control soil without earthworms

Time interval in days	Total organic matter in g/10² g dry soil	% change over initial culture soil	Total carbon content in g/10² g dry soil	% change over initial culture soil	Total nitrogen in g/10² g dry soil	% change over initial culture soil	C/N ratio	% change over initial culture soil
0	7.413 ± 0.02	–	4.3 ± 0.05	–	0.13 ± 0.02	–	33.08	–
7	7.329 ± 0.006	–1.133	4.251 ± 0.01	–1.139	0.1314 ± 0.0002	± 1.07	32.35	–2.206
15	7.312 ± 0.003	–1.362	4.240 ± 0.005	–1.395	0.1327 ± 0.0001	± 2.076	31.95	–3.415
25	7.286 ± 0.002	–1.713	4.225 ± 0.001	–1.744	0.1343 ± 0.0003	± 3.307	31.46	–4.897

similar result was observed by Julka and Mukherjee (1987) who studied the effect of *Amynthas diffringens* (Baird) on C/N ratio in hill soils. The present finding of decrease in C/N ratio upto 28.96% in amended soil by *Perionyx sansibaricus* (Michaelsen) is in agreement with the earlier observation. Senapati and Dash (1982) have observed that carbon and nitrogen contents of the soil with earthworms increased by 70% and 146% respectively in 25 days over the control without earthworms. An increase of 74.88% in total carbon, and 146.15% in total nitrogen over the control values 4.3 ± 0.05 and 0.13 ± 0.02 during the present investigation is in conformity with Senapati and Dash (1982). Goswami *et al.*, (2001) have also found similar trend while working with *Amynthas diffringens* (Baird) to estimate the percentage decomposition.

The soil can easily be amended from fertility viewpoint with the help of locally available earthworm *Perionyx sansibaricus*.

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