CHAPTER- III

OBSERVATIONS

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The observation on behavior, Morphology, body colorations, growth and breeding in the form of cocoon production of the earthworms were recorded during the experimental period of six weeks . For the above study preacclimatized earthworms were used . These observed changes in normal soil, semi- saline soil and total saline soil are discussed hereafter.

3.1 Observations On Various Parameters Studied In Relation To Different Substrate Soil Samples :-

The observations on various parameter of different substrate soil samples viz –total saline soil , semi-saline soil and normal soil are recorded in table No-2 and discussed as below-

i] Colour :- Colour of total saline soil was brownish black and was like a tea or coffee coloured, while the colour of semi-saline was lommy black and colour of normal soil was black.

ii] Temperature :- The temperature of the experimental substrate soil samples was measured time to time and maintained constant in the range of 25°C to 27°C

iii] pH :- The pH of total saline soil was 7.62 , the pH semi-saline soil was 7.84 where as the pH of normal soil was 7.69.

iv] Electric conductivity (E.C.):- The electric conductivity of total saline soil was 34.01 mmhos / cm, semi-saline soil was 5.08 mmhos / cm and normal saline soil was 0.21 mmhos / cm .

v] Nitrogen (N) :- The Nitrogen content of total saline soil was 36.25 Kg / ha, semi-saline soil was 46.87 Kg / ha, while the normal soil was 57.48 Kg / ha.

vi] Phosphorus (P) :- The Phosphorus present in total saline soil , semi-saline soil and normal soil was 21.14 , 27.25 and 26.94 Kg / ha respectively.

vii] Potassium (K) :- The Potassium of total saline soil was 164 Kg / ha while the semi-saline soil was 192 Kg/ha and normal soil was 217 Kg/ha.

viii] Calcium (Ca) :- The Calcium content of total saline soil , semi-saline soil and normal soil was 0.32 %, 0.17 % and 0.16 % respectively.

ix] Magnesium (Mg) :- The Magnesium of total saline soil was 0.44 % and semi-saline soil was 0.35 % where as the normal soil was 0.33 %.

Sr. No.	PARAMETER	UNIT	Value of total saline soil	Value of semi- saline soil	Value of normal soil
1.	Colour		Brownish black	Loamy black	Black
2.	pH		7.62	7.84	7.69
3.	E. Conductivity (E.C.)	mmhos/cm	34.01	5.08	0.21
4.	Nitrogen (N)	Kg/ha	36.25	46.87	57.48
5.	Phosphorus (P)	Kg/ha	21.14	27.25	26.94
6.	Potassium (K)	Kg/ha	164	192	217
7.	Calcium (Ca)	%	0.32	0.17	0.16
8.	Magnesium (Mg)	%	0.44	0.35	0.33
9.	Organic carbon (O.C.)	%	0.40	0.55	0.74
10.	Organic Matter (O. C.)	%	0.68	0.94	1.27
11.	Sodium (Na)	%	7.52	5.11	2.10
12.	Iron (Fe)	ppm	2.61	2.10	2.70
13.	Manganese (Mn)	ppm	0.35	0.14	0.65
14.	Zinc (Zn)	ppm	0.49	0.21	0.57
15.	Copper (Cu)	ppm	0.35	0.37	0.39

Table No.2 :- Chemical composition of different substrate media

x] Organic carbon (O.C) :- The Organic carbon of total saline soil was 0.40 % where as the semi-saline soil was 0.55 % and normal soil was 0.74 %.

Xi] Organic matter (O. M.) :- The organic matter found in the total saline is 0.68 per cent, while in semi-saline soil was 0.94 per cent The normal soil is reach in organic matter having 1.27 per cent.

xi] Sodium (Na) :- The Sodium of total saline soil , semi-saline soil and normal soil was 7.52 % , 5.11 % and 2.10 % respectively.

xii] Iron (Fe) :- The Iron of total saline soil was 2.61 ppm while the semi-saline soil was 2.10 ppm and normal soil was 2.70 ppm.

xiii] Manganese (Mn) :- The Manganese of total saline soil , semi-saline soil and normal soil was 0.35ppm , 0.14 ppm and 0.65 ppm respectively.

xiv] Zinc (Zn) :- The Zinc of total saline soil was 0.49 ppm while the semi-saline soil was 0.21 ppm where as the normal soil was 0.57 ppm.

xv] Copper (Cu) :- The Copper content of total saline soil was 0.35ppm and semi-saline soil was 0.37ppm where as the normal soil was 0.39 ppm.

3.2 Behavioral Observations :-

An earthworm is terrestrial animal which lives in the burrows of moist soil enriched with dead organic matter. Earthworms are nocturnal, hides in the burrows during the day and comes out during night in search of food and mate. In nature during rainy season, large number of earthworms found crawling on the soil surface, while in winter and summer they reach upto deeper part of the soil. In our present investigation when the worms were introduced in normal soil, immediately they get buried into soil and try to avoid day light.

i] Behavior of earthworm in total saline soil :-

After exposing to trough 'D1'and 'D2' containing total saline soil, the earthworms showed rapid movements and were tried to escape from the troughs. All earthworms of these batches have showed to stretch their anterior one third part of body in upright direction to avoid body contact with strongly saline soil. They were secreted large amount of slimy secretion from their body. This secretion may be due to irritation caused by salts present in the soil. Due to excess secretion of slimy fluid from the body , these worms were weakened and they lost, their natural

body stiffness. Finally they die due to the excess dehydration within a period of 5 to 7 minutes. The mortality rate was 100 per cent within a period of 5 to 7 minutes.

ii] Behavior of earthworm in semi-saline soil-

When the third batch of earthworms were exposed to trough 'C1' and 'C2' containing semi-saline soil , they showed crawling movements for a period of 2 to 3 minutes. Then they were secreted less amount of slimy secretions as compared to the exposure in total saline soil. Later on , they get buried into semi-saline soil. The mortality rate was 77.5 per cent during experimentation .

iii] Behavior of earthworms in normal soil-

When the acclimatized batch of earthworms was exposed to trough 'B1' and 'B2' containing normal soil showed behavior as in natural condition. They feel much comfortable. As they were placed in normal soil immediately they get buried into soil. The mortality rate was 2.5 per cent. In normal routine of six weeks of experimental period , these worms were showed feeding, breeding, crawling activities.

iv] Behavior of Earthworm in Buffalo dung-

When the acclimatized batch of earthworms were exposed to trough 'A1'and 'A2' containing buffalo dung , the earthworms showed vigorous feeding and breeding activities.

All these eight sets viz- trough 'D1' , 'D2' , 'C1' ,'C2' , 'B1' , 'B2' , 'A1' , 'A2' containing total saline soil , semi-saline soil , normal soil and buffalo dung respectively were provided with proper food in the form of vegetable waste. The amount of supplementary food provided to worm was 50 gram per trough per week. The moisture content of soil and temperature was maintained by daily watering with the help of spray pump.

3.3 Morphological Observations-

The morphological observations were recorded in the form of weight loss and weight gain.

i] Morphological observations in total saline soil-

In total saline soil, as there was 100 % mortality within the period of 24 hour, there was no chance for feeding, growth and breeding.

Sr. No.	Name of set	No. of earthworms released	Survival rate after			Mortality in %	Mean Mortality in Per cent
			15 Min.	30 Min.	24 hours		
1.	Buffalo dung Manure [A_1]	20	20	20	20	0.0 %	0.0 %
2.	Buffalo dung Manure [A_2]	20	20	20	20	0.0 %	
3.	Normal soil [B_1]	20	19	19	19	5.0 %	2.5 %
4.	Normal soil [B_2]	20	20	20	20	0.0 %	
5.	Semi saline [C_1]	20	14	10	05	75 %	77.5 %
6.	Semi saline [C_2]	20	13	08	04	80 %	
7.	Total saline[D_1]	20	06	02	00	100 %	100 %
8.	Total saline[D_2]	20	04	00	00	100 %	

Table No 3 :- Mortality of earthworm *'Eisenia foetida'* .

Sr. No..	Name of set	No. of earthworms released	Total weight of earthworm. `A`	Average wt. at the time of release. `a`	Total weight of earthworm.after 6 weeks of exposure. `B`	Average wt. at the end of expt. `b`	Change in biomass (weight) difference. (b-a)	Mean change in body weight	Percentage ratio of wt. gained to initial body weight (RGR)
1.	A1.	20	6.508	0.3254	8.068 (20)	0.4034	0.078	0.079	24.27 %
2.	A2.	20	6.508	0.3254	8.108 (20)	0.4054	0.080		
3.	B1.	20	6.500	0.3250	6.7374 (19)	0.3540	0.0296	0.027	8.35 %
4.	B2.	20	6.434	0.3217	6.934 (20)	0.3467	0.025		
5.	C1.	20	6.500	0.3250	1.025(5)	0.205	-0.12	-0.105	-32.35 %
6.	C2.	20	6.480	0.3240	0.936 (04)	0.234	-0.09		
7.	D1.	20	6.552	0.3276	0.00 (00)	0.00	-0.3276	- 0.3265	0.0 %
8.	D2.	20	6.508	0.3254	0.00 (00)	0.00	-0.3254		

Table No. 4 :- Change in Biomass (weight in gms.) of *E. foetida* [fig. in bracket shows no. of earthworm]

ii] Morphological observations in semi-saline soil-

As the mortality of worm in semi-saline soil was 77.5 %, the remaining 22.5 % of the worms showed, growth pattern as showed in table No – 3. The Average weight of the worm was 324 mgs before exposure to semi-saline soil where as the average weight of worms after six weeks of exposure was 219 mgs. Thus the average reduction in weight was 8 mgs and the per cent reduction was 32.25 per cent .

iii] Morphological observations in normal soil-

The morphological observation in the form of change in body weight is recorded in table No. 4 . In normal soil the worms were fed on the organic matter present in the soil , as well as on supplementary food. The growth of worm was remarkable. At the beginning, the average weight was 327 mgs. where as after six weeks of exposure , the average weight recorded was 35o mgs. Thus the average increase in weight of earthworm was 27 mgs and the per cent increase was 8.35 %.

iv] Morphological observation of earthworms in buffalo dung.

The observation on weight gain of worms in mgs are recorded in table No -4.

The average body weight of worm before exposure to trough ' A1' and 'A2' was 325 mgs whereas after six weeks of exposure the average weight observed was 404 mgs. Thus the weight gain after six weeks was 79 mgs and the per cent increase was 24.27 % .

3.4 Observations on feeding of earthworm *Eisenia foetida-*

In normal soil, some earthworms were feeding on soil containing organic matter with the help of their suctorial mouth. During feeding their bucco-pharyngeal mass was protruded out and along with food again it was retracted and this feeding process was continuous.

3.5 Observations on breeding of earthworm *Eisenia foetida-*

As the earthworms are nocturnal, generally they come out from their burrows during night in search of food and mate. During the period of six weeks of experimentation from 10 pm to 5 am , some earthworms were found to be crawled on soil surface.

Sr. No	Name of set	Nature of substrate sample	No. of worms Survived up to the end of six weeks	No. of cocoons collected	No. of pre juveniles (Babys) observed	Total no. of earthworms without clitellum (juvenile)	Total no. of earthworms with clitellum (Adult)	Net Reproductive Rate (Nrr)* Total No. of Ew harvested Nrr = ---------- Total. No. Ew stocked × Period(wk.)	
1.	A1.	Buffalow dung	20	85	65	50	36	1.25	1.23
2.	A2.	---//---	20	87	69	46	32	1.22	
3.	B1.	Normal soil	19	74	52	42	28	1.07	1.04
4.	B2.	---//---	20	78	58	39	26	1.02	
5.	C1.	Semi saline soil	05	21	09	06	05	0.66	0.68
6.	C2.	---//---	04	16	08	05	04	0.70	
7.	D1.	Total saline soil	0.00	Nil	-------	-------	00	0.00	0.0
8.	D2.	---//---	0.00	Nil	-------	------	00	0.00	

Table No.5 :- Breeding potential of Earthworm *E. foetida*.[* = as per Dynes (2003)].

Plate No.- 4, Fig 1 to 3

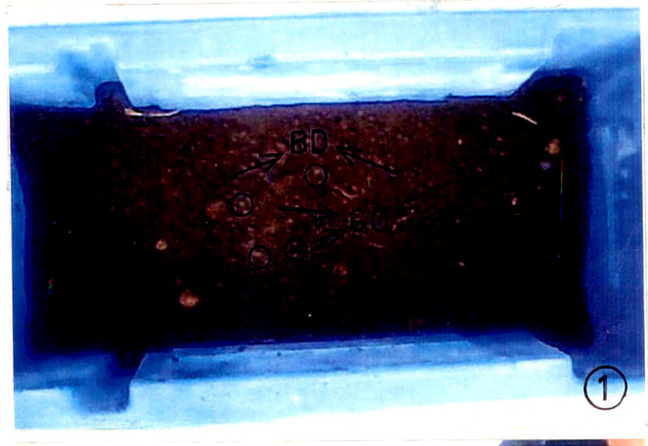
(Cocoons of *Eisenia Foetida* in different substrate media)

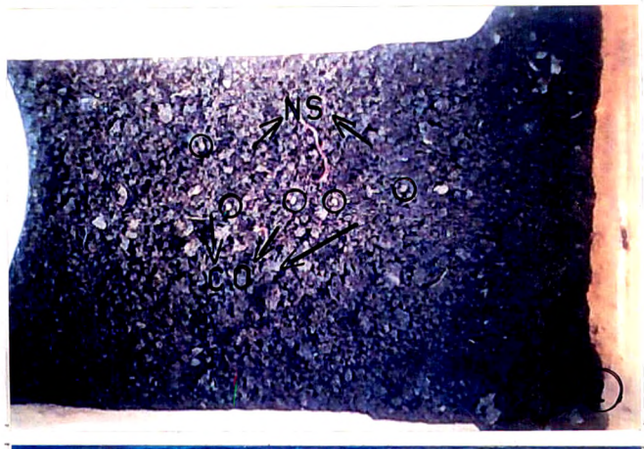
Fig.1. The cocoons of *Eisenia Foetida* in buffelow dung.

Fig.2. The cocoons of *Eisenia Foetida* in normal soil.

Fig. 3. The cocoons of *Eisenia Foetida* in semi saline soil.

PLATE NO.4





Breeding of earthworms *Eisenia foetida* in relation to mating, cocoon production in various soil samples such as saline soil, semi-saline soil, normal soil and in buffalo dung is discussed hereafter.

i] Breeding behavior of earthworm in total saline soil-

As stated earlier in total saline soil the mortality rate was 100 %. The mating and cocoon production was not observed in this soil sample.

ii] Breeding behavior of earthworms in semi-saline soil-

In semi-saline soil mortality was 77.5 % , but in remaining 22.5 % of the earthworms were showed breeding. The cocoons were found in upper soil surface. The size of cocoon was 4.0 mm x 3.0 mm and was comparatively smaller than the cocoons found in normal soil and in buffalo dung.

The average size of cocoon in the normal soil was 5.0 mm x 3.oo mm where as number of cocoon was 3/ set / weeks. These cocoons were collected from the soil surface and were placed in separate trough containing semi-saline soil. These cocoons were photographed as shown in plate No. 4 figs. No 1 to 3 .

iii] Breeding behavior of earthworms in normal soil-

During the period of six weeks , at night mating was observed for 2 to 3 times when two worms came togather with their opposite ends and ventral surfaces. The number of cocoons found in this trough was 76 having average size of about 5 mm x 3 mm. For further study cocoons of this trough were collected and placed in separate trough containing normal soil. The reproduction success was measured in terms of hatchings .

In the present investigation 1 to 2 Juveniles were hatched from single cocoon. The newly hatched youngones were photographed and are showed in plate No. 5 figs 1 to 3

iv] Breeding behavior of earthworm in buffalo dung-

In buffalo dung earthworms were feeds, grows and breeds much successfully as compaired to semi-saline soil and normal soil. The number of cocoon produced were 86 having average size of about 5 mm x 4 mm. From each cocoon on an average two Juveniles were hatched successfully which are shown in plate No. 5 figs - 1 to 3.

Plate No.- 5 , Fig. 1 to 3

(Various life cycle stages of Earthworm *Eisenia Foetida*)

Fig.1. The adult, cocoons, juvenils and immature worms of *Eisenia Foetida.*

Fig.2. The cocoons and juvenils of *Eisenia Foetida.*

Fig.3. The immature worms of *Eisenia Foetida.*

PLATE NO.5