NEW COLONISATION OF LUMBRICID *ALLOLOBOPHORA PARVA* EISEN. (OLIGOCHAETA) IN GREAT THAR DESERT SOILS: DISPERSAL AND ECOPHYSIOLOGY

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ABSTRACT

Lumbricids require optimum pedo-ecological condition in their environment and rarely present in arid soils. During the Survey of Great Indian Thar desert a Lumbricid species *Allolobophora parva* was recorded from first time from Indian Arid Lands. *A. parva* was recorded from northern – irrigated lands of Great Thar desert mainly restricted in some sites of Sri Ganganagar and Hanumangarh districts. Maximum species density of *A. parva* was recorded 84. 2 ind. m^{-2}± 49.6 in Litter layers. Some other habitats i.e. sewage soil, soils of irrigation channels also showed good population of *A. parva*. The soile moisture and nitrogen content showed significant ($P < 0.05$) relationship with *A. parva* density in different habitats.

Key Words: Earthworm Fauna, Thar Desert, Lumbricidae, *A. parva*

INTRODUCTION:-

There are about 200 species of Lumbricidae found worldwide occurring in a variety of habitats, ranging from grasslands of the marine coast of alpine meadows, from open pasture to dense forest, from acid bigs to alkaline upland soils. Because all Lumbricids share a requirement for adequate moisture in their environment, they rarely occur in dry or desert regions (Schwert, 1990). The ecology of Lumbricids has summarised by many workers (Bouche, 1972, Edwards and Lofty, 1972, Satchell, 1983 and Lee, 1985)

Since, Lumbricids appeared as major among the earthworm communities of Europe and Australia. The family lumbricidae is endemic throughout the palaeartic region and easter North America. A number of species have been introduced into almost all the zoogeographical regions of the world. Lumbricids posses inherent ability to colonise wide range of soil type and microclimates. Peregnine Lumbricids name acquired domicile in India at hill resorts with a temperate-like climate in the Himalaya, and Nilgiri and Palni Hills in the Peninsula. They are more widely distributed in western Himalayas and form a dominant group in habitats at some places. (Julka, 1993).

The burrowing activity o Lumbricids serves not only for movement within a protected environment, but for the gathering and ingestion of nutrient material. Edward and Lofty (1972) have summarize research, indicating not much o the mineral component ingested by members of the Lumbricidae is returned in these castings to the soil in forms more readily available to plants.

During the survey of Great Indian Thar desert Lumbricid *Allolobophora parva* Eisen has been reported from many habitat of Northern irrigated land of Great Thar desert (Suthar, 2002). In this paper efforts has been made to evaluate the distribution, habitat structure and interaction with soil physio-chemical parameters in relation to their adaptability and colonisation in this region.

MATERIAL & METHOD:

Site description:-

The study site is popularly known as great Indian Thar desert which occupies about 28.57 m ha land of India and situated at $22^0$33" to 32^0 05" N and from 68^0 05" to 75^0 45" E covering western part of Rajasthan state (69 %), Gujrat state (21 %) and Southern-Western part of the Harayana and Punjab state (10 %). The desert in bordered by irrigated Indus plain in the east, international border with the Pakistan in west and archean Aravalli hill ranges in the east. The air temperature in May-June touches 50^0 C and -3^0 C or even less in January – February, characterise Thar desert. The mean annual rain fall in desert region of Rajasthan is 345 mm varying spatially from less than 100 mm in the western part (Jaisalmer district). Low available water capacity, vulnerability to wind erosion and low fertility are major constraints of this region. Desert region of Rajasthan has plain lands without stream network, about 30% of the region has sloppy lands with stream network mainly in the Luni basin and about 20% of the region is covered under Indira Gandhi canal command area.

Earthworm Sampling:-

Earthworm collected from different possible habitats from Great Thar desert soils i.e. sewage soil : urban sewage like house sewage, kitchen sewage and sewage near the drinking water resources; agriculture soil : cultivated land with different crop rotations, near the source of agriculture field water supply like tube well or in or near irrigation channel; garden soil : home garden, kitchen garden, lawns, grass cover, city parks and garden at public places; waste land : waste land near the agriculture field, roadsides and in public park etc.; compost pits : situated in agriculture field, animal yard or even in houses and plant litter layers in gardens, agriculture field, houses etc.

Earthworm collected by hand sorting method as described by Julka (1988). Sampling was done throughout the year in morning and evening hours except the Dec. – Jan. and May – June months with extreme season conditions. The digging was done up to 20 cms depth. The soil lumps were broken and the soil passed through the fingers to sort out the worms. Earthworms were determined to species level and developmental stages were distinguished clitellate and aclitellate. The collected samples of earthworm were brought to laboratory along with sufficient amount of soil in poly bags having a label which indicates date of collection, habitat, place name, vegetation etc.

Soil analysis:-

Soil pH and temperature was measured by using digital hand pH meter and soil thermometer, respectively. Soil moisture content was estimated gravimetrically on a wet basis by oven drying at 105 ^{0}C. Soil carbon was determine by using Walkey – Black method. The total soil nitrogen was determined by following the microkjeldhal method.

RESULT

During present survey single species of family Lumbricidae i.e. *Allolobophera parva* Eisen. was recorded and this was recorded for first time from Great Indian Thar desert. *A. Parva* showed patchy distribution in some very special restricted habitat in northern irrigated land of Sri Ganganagar and Hanumangarh districts of Rajasthan, which are under the influence of Great Indian Thar desert. *A. parva* showed repeated presence in the habitat with high organic materials like leaf litter layer, compost pits and sewage soils etc. (Table 1). During present survey the worm density of *A. parva* varied drastically from maximum 84.2 ind. m^{-2} ± 49.6 in leaf litter layer to minimum 42.6 ind. m^{-2} in both agriculture field and grass lands. Sewage soils and wet soils of water channel also showed good population 53.0 ind. m^{-2}± 33.0 and 59.0 ind. m^{-2}, respectively (Table 1). *A. parva* showed a wide range of soil physiochemical parameters in their habitats and was found between the ranges of 7.6 – 8.8 soil pH, 10.12 – 34.15 % soil moisture, 18.33 – 29.15 ^{0}C temperature, 3.65 – 7.10 g Kg^{-1} organic carbon, 1.07 – 2.96 g Kg^{-1} nitrogen and 2.13 – 5.05 soil C/N ratio.

DISCUSSION

Lumbricids share a adequate moisture and organic matter in their habitats and rarely found in threatened habitats. During present survey Lumbricid *A. parva* was recorded in Northern irrigated districts of Great Indian Thar Desert. Since, this region is most productive and considered as 'pot of grains'. High availability of water as well as organic matter contents in most soils of this region with highly diversified flora and cultivation practices provides good opportunities to colonize the Lumbricid population. Northern part of Thar desert also receive a good network of canal, rivers and rainy streams originated from Himalayas and Indo-Gangetic plains which acted as the passive migrant for introduction of many earthworm species in this regions (Suthar, 2002). Since, *A. parva* is widely distributed in northern Himalayas of India and it has successful colonised in many soils of northern irrigated land of Great Indian Thar desert possibly introduced by water bodies originated from Himalayas.

The climate of desert is characterised by high air temperature, threatened soil and water resources and thin surface vegetations. Several physical and chemical environmental factors have been suggested as determinants of the distribution and abundance of earthworm in soil. These include available moisture, temperature, soil texture, soil depth organic contents, C/N ratio calcium content and soil pH (Lee, 1985).

Nevertheless, the structure of world earthworm community is mainly determined by the temperature. However, when temperature is the same in markedey different adaphic or environmental conditions, other factor tend-to be predominant. (Fragoso and Lavelle, 1992). Thus temperature did not show any significant difference in different parts of Great Thar desert but other pedo-ecological (organic matter content, surface vegetations) factors varied drastically at the lower hierarchical level and checks the colonisation and succession of *A. parva* population in other parts of Thar desert. Nevertheless, seasonal earthworm mortality in temperate soils have generally being attributed to moisture stress rather than to temperature extremes (Gerard, 1967; Phillipson *et al.*, 1976).

The soil moisture act as major factor in worm distribution in soils. Optimal soil moisture content varied for different species and ecological category and within species these appears to be a considerable capacity to adapt to local conditions (Lee, 1985). As data shows in present study *A.parva* restricted in habitat with higher moisture level, and a significant relationship ($r = 0.540$, $P < 0.05$) between worm density and soil moisture content of different habitats was recorded. (Fig. 1).

A. parva is a epigeic and pigmented Lumbricid species. Epigeic mainly feed on leaf litter or dung mixed with some soil. According to Fragoso and Lavelle (1992) epigeic act as efficient agents of communication and fragmentation of leaf litter that they transform in stabilised organic matter. The higher density of *A. parva* in litter layer, compost pits and sewage soils during present study strong the hypothesis of previous workers. Organic matter content appeared major factor for worm dispersal in Thar desert and worm density close significant relationship with organic matter in different habitats.

The number and biomass of Lumbricids closely related to quantity and quality of organic matter contents in soils (Edwards and Lofty, 1972, Satchell, 1983, Lee, 1985, Hendrix *et al.*, 1992). The relative abundance and biomass of earthworm appeared to decrease with decline in soil physio-chemistry (Reynolds, 1972). Similarly El-Duweini and Ghabbour (1965) summarised the relationship between Lumbricid *Aporrectodea caliginosa* and soil properties of Egyptian arid soils. During present study the density of Lumbricid *A. Parva* showed close relationship ($r = 0.616$, $P < 0.05$) with nitrogen contents (Fig. 2).

CONCLUSION

Lumbricid require adequate moisture and organic matter contents in their habitats. Very little information are available on the distribution of Lumbricids in arid lands. Due to suitable microclimate and pedo-ecological conditions in northern irrigated land of Thar desert Lumbricid *A. parva* has successful colonized in many habitats with higher moisture and organic inputs. It can hypothesized that introduced water bodies from Himalayan region in Thar desert has changed the pedo-climatic condition and dramatically leads to colonization and successful establishment of many plant as well as animal species from Great Himalaya to Thar desert soils.

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