Bull. zool. Surv. India, 5 (2 & 3) : 35-39, 1984

SOME OBSERVATION ON THE SEASONAL ACTIVITY OF EARTHWORMS (OLIGOCHAETA : ANNELIDA) IN HILL FOREST SOIL

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ABSTRACT

Data gathered during the period July 1978—June 1979 indicate seasonal fluctuations in the population size of earthworms in hill forest soil at Solan, Himachal Pradesh, India. Significant positive correlation exists between changes in the population size of *Octolasion tyrtaeum* (Savigny), the most predominant species, and soil moisture, but not between soil temperature and the seasonal abundance of this speces. The seasonal distribution by age groupings of *O. trytaeum and Drawida japonica* Michaelsen is also given.

INTRODUCTION

Ecological studies on oriental earthworms have remained neglected. Few detailed investigations on their seasonal activity and population dynamics are those of Roy (1957), Gates (1961), Bhatti (1962), Dash and Patra (1977), Kale and Krishnamoorthy (1978), Reddy and Alfred (1978), Senapati *et al.*, (1979, 1979a), Chauhan (1980) and Dash and Senapati (1980). This article presents preliminary observations on the influence of soil temperature and soil moisture on the earthworm population in an ash-tree stand during the course of a year.

STUDY AREA

An area of 10 × 10 m was selected for the present study in a forest (Shilli Forest) at an altitude of 1480 m, about 4 km from Solan on way to Jaunaji. The site was close to the Forest Nursery of the local College of Agriculture. Vegetation of the site was primarily composed of *Fraxinus americana* Linn. (Ash), *Quercus incana* Roxb. (Oak) and *Pinus roxburghii* Sarg. (Pine) and some grasses on the edge of the forest.

The study area experienced four distinct seasons viz. spring (late February to April), summer (May to August), autumn (September to middle of November) and winter (middle of November to middle of February).

MATERIAL AND METHODS

During the present study, earthworms were extracted from soil by formaldehyde solution as described by Raw (1959) since the digging and handsorting method is very time consuming. Every month ten samples,

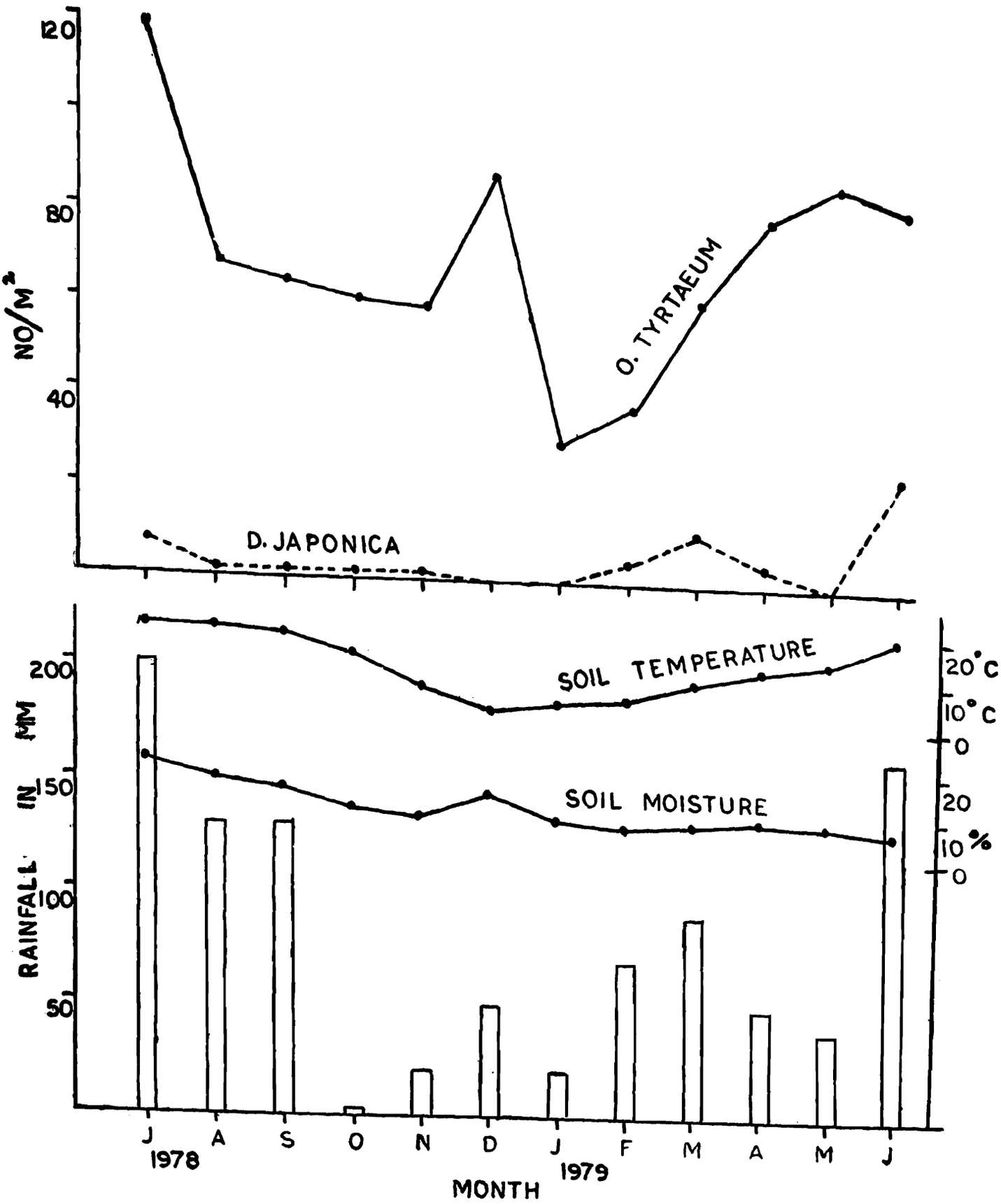
NO/M²
120
80
40
O. TYRTAEUM
D. JAPONICA
RAINFALL IN MM
200
150
100
50
SOIL TEMPERATURE
SOIL MOISTURE
20°C
10°C
0
20
10%
0
J
A
S
O
N
D
J
F
M
A
M
J
1978
1979
MONTH

FIG. 1

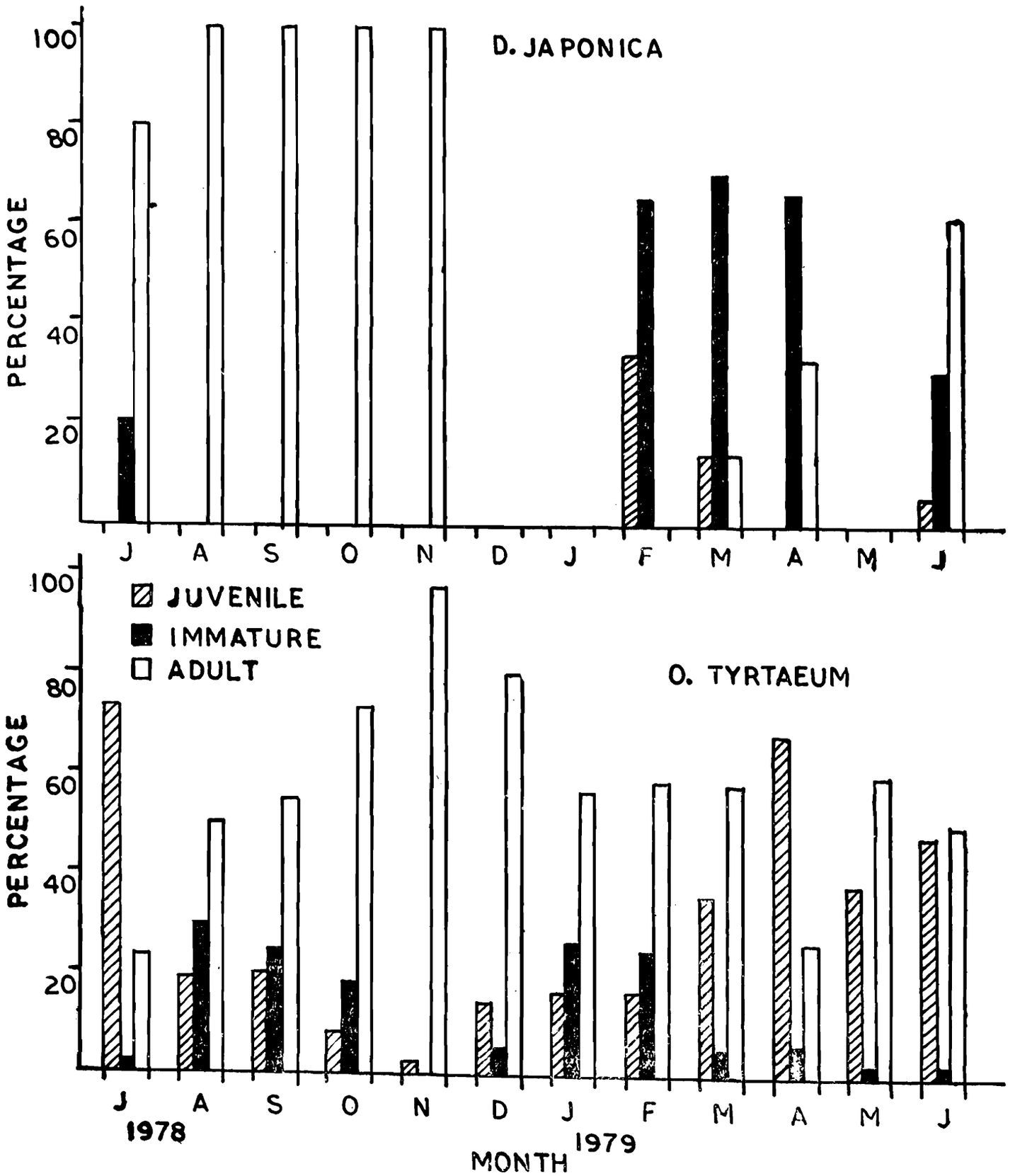
D. JAPONICA
PERCENTAGE
100
80
60
40
20
J A S O N D J F M A M J
JUVENILE
IMMATURE
ADULT
O. TYRTAEUM
PERCENTAGE
100
80
60
40
20
J A S O N D J F M A M J
1978
1979
MONTH

FIG.2

each 25 cm × 25 cm quadrat, were taken during the period July 1978—June 1979 by random sampling method. Soil temperature and moisture were measured respectively by a soil thermometer and by oven-drying method for the surface soil at 5 cm depth. Rainfall data was obtained from the local College of Agriculture, Himachal Pradesh Krishi Vishva Vidhyalaya.

Observations

Rainfall and Physico-Chemical Factors of the Soil

The seasonal changes in the rainfall, soil moisture and soil temperature are depicted in Fig. 1. The pH of the soil ranged from 7·0 to 7·4.

Species Diversity and Dominance

Octolasion tyrtaeum (Savigny), *Bimastos parvus* (Eisen) (Fam. Lumbricidae), *Drawida japonica* Michaelsen (Fam. Moniligastridae) and *Plutellus* sp. (Fam. Acanthodrilidae) were recorded in the samples. *O. tyrtaeum* with an annual percentage of 92·9 showed a marked predominance, followed by *D. japonica* (6·7%), *B. parvus* (0·2%) and *Plutellus* sp. (0·2%).

Seasonal Activity

Population of *O. tyrtaeum* showed two maxima and two minima in a year (Fig. 1). Population increased in late February and the trend continued upwards through the spring until the peak (118·4/m²) was reached in July at the beginning of summer rains. The number dropped rapidly in August and continued to decrease during the autumn until November. Coinciding with the onset of winter rains in late December, the number rose again but did not reach the previous level. Population declined to the lowest level of 30·4/m² in January.

Seasonal distribution of *O. tyrtaeum* by age groupings is illustrated in Fig. 2. The autumn and winter populations were predominently made up of adults. During the spring in April, there was a considerable increase in the percentage of juveniles, a significant decline in percentage of aclitellate adults and clitellate adults. During the summer, the percentage of juveniles decreased slightly in May and June but increased very significantly in July at the beginning of the rainy season. This species seems to reproduce throughout the year with the reproduction peak in the autumn and winter, decreasing through the spring and summer.

A definite trend in the seasonal activity of *D. japonica* could not be drawn due to its low population. This species was not encountered during the winter and early summer. Beginning in February, the number increased to a minor peak (11·2/m²) in March followed by a significant decline in April (Fig. 1). A second build-up in the population occurred in June which was also the maximum (25·6/m²) for the year. The population was at the lowest level from middle of the summer through the autumn.

The main reproductive period in *D. japonica* appears to be from late summer rainy season to the autumn (Fig. 2). During this period, the population was exclusively made up of clitellate adults. In late winter and early spring, only juveniles and aclitellate adults were found. There was a significant decrease in the percentage of juveniles and a

slight increase in the percentage of aclitellate adults during the spring.

Bimastos parvus (Eisen) and *Plutellus* sp. were recorded only on one occasion and their seasonal activity cannot be ascertained.

DISCUSSION

Two most important factors that affect seasonal activity of earthworms are soil temperature and soil moisture (Evans and Guild, 1947 ; Reynolds and Jordan, 1975 ; Edwards and Lofty, 1977). The influence of these two parameters on the seasonal activity of *O. tyrtaeum*, the most predominant species, was analysed statistically. A significant positive correlation ($r = 0{\cdot}564$; $p < 0.05$) between soil moisture and abundance of this species was obtained. According to Michon (1949) and Grant (1955), *O. lacteum* (a synonym of *O. tyrtaeum*) cannot survive very dry conditions. The earthworm density pattern in direct proportion to soil moisture was also recorded by Evans and Guild (1947), Satchell (1967) and Reynolds (1972).

Gates (1961), Dash and Patra (1977) and Dash and Senapati (1980) reported that earthworms were mainly active during the summer rains between May and October in the tropical climate of Burma and subtropical climate of India. The soil temperature and moisture largely controlled the seasonal trend in their population densities. These studies were mainly based on the non-lumbricid earthworms. On the contrary, *O. tyrtaeum* (a lumbricid) was observed to be active throughout the year with phases of high population density coinciding with the early summer rains and early winter rains. The low soil temperature at the beginning of the winter rainy season was not found to be a limiting factor in the seasonal abundance of this species at Solan having a temperate-like climate. The effect of soil temperature was also non-significant statistically ($r = 0{\cdot}498$). Like other Indian lumbricids, excepting *B. parvus*, the original home of *O. tyrtaeum* is in temperate Europe and possesses an inherent ability to withstand the rigors of low soil temperature (Gates, 1958, 1972). The Indian lumbricids are presumed to have been transported from Europe by man unintentionally in soil around roots of exotic plants and could colonize successfully only in the hilly areas with a temperate-like climate (Gates, 1958).

The reproduction peak in *O. tyrtaeum* occurred in autumn and winter. However, Reynolds *et al.*, (1974) recorded the maximum reproductive activity for this species during the autumn, winter and spring periods in North America. The main reproductive period in *Drawida japonica* was from late summer rainy season to autumn which more or less agrees with the observations of Senapati *et al.*, (1979a) on *Drawida calebi* Gates.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta for providing necessary facilities. They are also thankful to Dr. Asket Singh, Officer-in-Charge, High Altitude Zoology Field Station, Zoological Survey of India, Solan for encouragement.

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