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Safina KousarDepartment of Zoology, G.C.
University, Faisalabad, Pakistan**Muazzma Akhter**Department of Zoology, G.C.
University, Faisalabad, Pakistan

Population density of earthworms species in the mango and date palm orchards in Faisalabad, Pakistan

Safina Kousar and Muazzma Akhter

Abstract

Earthworms are beneficial fauna residing under soil and play a vital role to improve soil health which ultimately enhance the yield of produce. In the present studies population density of earthworm were observed in date palm and mango orchards. Total 192 sampling sites (96 under the canopy and 96 away from the canopy) were selected for study. From these sampling sites, 12 sampling sites (6 for Mango and 6 for Date palm fields) were selected randomly by the replacement sampling method every week. From Mango field 90 (under the canopy 48 and away from the canopy 42) while in Date palm field 55 (under the canopy 30 and away from the canopy 25) specimens were collected.

Keywords: Earthworm, mango, date palm, population density

Introduction

Mango is the fruit par excellence of Subcontinent. Mango (*Mangifera indica*) belongs to the family Anacardiaceae. Pakistan is an important mango growing country in the world. The soil and climatic conditions of Pakistan are highly suitable for mango cultivation. According to FAO production year book of 2001, Pakistan stands fifth among mango growing countries of the World. Mango enjoys second position after citrus in Pakistan. It is grown in the province of Punjab over an area of 48413 hectares out of 94121 hectares in the country. At present the total annual production of fruits in Pakistan is 58, 46, 342 tons.

Regarding the cultivation of date palm in 2001, Pakistan was among the top five date producing countries i.e. Egypt, Iran, Saudi Arabia, Pakistan and Iraq, accounting for about 69% of total production [3].

According to the current estimation, the numbers of existing species of earthworms are far from complete. The most recent account of earthworm diversity comprises 3627 earthworm species described worldwide with an average annual addition of 68 species [21]. Diverse significance of earthworms has been reported by a number of scientists: in increase of productivity of plants [8, 13, 23] in soil fertility and recycling of nutrients [15, 16] in enhancing nitrogen metabolism in pollution control by treating the waste [10, 1] to prevent waste water pollution from sugar mills, paper mills, distillery wastes, food processing units [2]; in bioaccumulation for the removal of heavy metals [11] and in mineralization of C and N. Earthworms have linoleic and arachidonic acids that are required for the growth and reproduction of animals so are used in animal feed industry in dried and powdered forms [12]. The number of earthworms in regularly cultivated arable soils is usually very variable and populations are intermediate in size between the more sterile habitats and those in pastures and natural grassland, which can support large number of earthworms [7]. It is lamentable that very few studies on the identification and abundance of the earthworms in some habitats of the Punjab are available [17, 18]. Species number and ecological categories (e.g. epigeic, endogeic and anecic) are favored as key indication parameters in agro ecosystems [14]. In Faisalabad region the soil is mostly sandy loam harbouring *Pheretima posthuma* and its congeners in most of the cultivated crops and along water bodies amongst the cultivations [17, 18].

Earthworm are influenced by soil type and texture. Earthworms act as a barometer for soil health. Earthworms cannot flourish in habitat of cropland where synthetic fertilizers and pesticides are of paramount importance [22]. Earthworms could possibly help in digesting decayed plant materials in soil mostly within the depth of 30 cm for their food and produce a number of earthworm casts.

Corresponding Author:**Safina Kousar**Department of Zoology, G.C.
University, Faisalabad, Pakistan

Furthermore their movement in soil together with earthworm casts could possibly help in improving soil condition hence the physical and chemical properties of the soil could possibly be improved [5]. The growth and survival rates of earthworms showed significant positive correlations with percent of organic matter [9].

Need of knowledge of earthworm ecology to exploit this natural resource for the benefit of mankind does not require any debate. So, the present study was aimed at knowing the abundance and diversity of earthworms in fields of *Mangifera indica* and *Phoenix dactylifera* at Post Graduate Agriculture Research Station (PARS) Jhang Road Faisalabad. Soil analysis with respect to its texture, pH, phosphorus, potassium and organic matter was also made to study the effect of these factors on the earthworm population of these fields.

Materials and Methods

The earthworms were collected from the fields of Mango and Date palm by digging and hand sorting method (Lewis and Taylor, 1979) at Post Graduate Agriculture Research Station Jhang Road Faisalabad and identified in the research lab of Department of Zoology G.C. University, Faisalabad.

Collection

Total 192 sampling sites (96 for Mango and 96 for Date palm fields) were selected for study. From these sampling sites 12 sampling sites for a week (6 for Mango and 6 for Date palm fields) were randomly selected by the replacement sampling method.

A hole of one square feet was dug with the help of spade and scraper in each selected site and earthworms and soil samples were collected. The collected specimens were preserved in glass jars. The data regarding date of collection, soil depth and field conditions, ploughed, unploughed, wet and dry in the respect of each specimen were recorded. The collection was made weekly for four months from July to October 2006.

Preservation

The specimens were preserved by the following method suggested by Stephenson (1923). The earthworms were washed with tap water and kept in 10% ethyl alcohol for ten minutes for dehydration and hardened by keeping in 10% formalin for about 24 hours and then finally preserved in 5% formalin.

Identification

The specimens were identified with the help of identification keys, diagrams, and descriptions provided by Stephenson (1923) and Bhatti (1962).

Specimens were examined by binocular range of 10-40x. The data regarding abundance and the diversity of earthworm species were recorded for mango and date palm fields. After identification and measurements, the specimens of each species were kept in separate jars with the inscribed species name and were kept in museum of Department of Zoology G.C. University, Faisalabad.

Following steel *et al.* (1996) correlation and Simpson

diversity index were applied for the analysis of data.

$$\text{Simpson's index for diversity} = D = \frac{\sum n(n-1)}{N(N-1)}$$

Result

Total 192 sampling sites (96 under the canopy and 96 away from the canopy) were selected for study. From these, 12 sampling sites (6 for mango field and 6 for date palm fields) were selected randomly by the replacement sampling method every week.

Figure-2: Shows that total fourteen species namely *Pheretima posthuma*, *Pheretima taprobanae*, *Pheretima minima*, *Eutyphoeus ineammodus*, *Pheretima linnicola*, *Aporrectodea longa*, *Pheretima anomala*, *Pheretima californica*, *Aporrectodea caliginosa*, *Pheretima carinensis*, *Pheretima diffrengeis*, *Pheretima suctoria*, *Pheretima bournna*, *Pheretima hawayana* were inhabitants of study area in both habitats. Two Species namely were *Pheretima lignicola* and *Eutyphoeus ineammodus* restricted to the under the canopy habitat. The value of Simpson diversity index was $D=0.25$ Table: 1 (under and away the canopy) while Simpson diversity index under the canopy was (0.17) Table: 2 and away the canopy was (0.39) Table: 3.

Month wise mean number of earthworm abundance under and away mango canopy

Figure-1: Shows the mean relative abundance of earthworms under and away the canopy in mango field from July to October. The mean number of earthworm number was maximum in August (under the canopy) and in September (away the canopy) $\bar{X}=1.25$, $\bar{X}=1.5$ while it was minimum in October (under and away the canopy) $\bar{X}=0.75$, $\bar{X}=0.41$ in mango field.

Figure-2: Shows that non-significant relationship was found between mean number of earthworms (under and away the canopy) because ($r=0.22$, $P>0.05$).

Month wise mean number of earthworm abundance under and away Date palm canopy

Figure-1: Shows the mean relative abundance of earthworms under and away the canopy in date palm field from July to October. The mean number of earthworm was maximum in September (under and away the canopy) $\bar{X}=1$, $\bar{X}=1$ while it was minimum in October (under and away the canopy) $\bar{X}=0.166$, $\bar{X}=0.166$ in date palm field.

of earthworms (under and away the canopy). ($r=0.833$, $P>0.05$).

Relative abundance of mean number of earthworms in Mango and Date palm fields

Figures-2: Shows that the mean number of earthworm was greater in the Mango field as compared to that of Date palm in both the habitats (under and away the canopy) through out the study period except that it was equal in September in both fields in under the canopy habitats.

Table 1: Simpson’s diversity index for earthworms in Mango field (under and away the canopy).

Species Name	Number(n)	n(n-1)
<i>Pheretima posthuma</i>	42	1722
<i>Pheretima taprobanae</i>	2	2
<i>Pheretima minima</i>	2	0
<i>Eutyphoeus ineammodus</i>	3	12
<i>Pheretima lignicola</i>	8	42
<i>Aporrectodae longa</i>	2	2
<i>Pheretima anomala</i>	8	56
<i>Pheretima californica</i>	3	6
<i>Aporrectodae caliginosa</i>	2	2
<i>Pheretima carinensis</i>	5	20
<i>Pheretima diffrenses</i>	4	12
<i>Pheretima suctoria</i>	4	12
<i>Pheretima bourna</i>	2	2
<i>Pheretima hawayana</i>	1	0
	N=88	∑n(n-1)=1890

$$\begin{aligned}
 \text{Simpson's diversity index } D &= \frac{\sum n(n-1)}{N(N-1)} \\
 &= \frac{1890}{7656} \\
 &= 0.25
 \end{aligned}$$

Table 2: Simpson’s diversity index for earthworms in Date palm field (under and away the canopy).

Species Name	Number(n)	n(n-1)
<i>Pheretima posthuma</i>	23	506
<i>Pheretima taprobanae</i>	2	2
<i>Pheretima minima</i>	2	2
<i>Eutyphoeus ineammodus</i>	4	12
<i>Pheretima lignicola</i>	4	12
<i>Aporrectodae longa</i>	2	2
<i>Pheretima anomala</i>	2	2
<i>Pheretima californica</i>	2	2
<i>Pheretima carinensis</i>	3	6
<i>Pheretima diffrenses</i>	2	2
	N=46	∑n(n-1)=548

$$\begin{aligned}
 \text{Simpson's diversity index } D &= \frac{\sum n(n-1)}{N(N-1)} \\
 &= \frac{548}{2070} \\
 &= 0.26
 \end{aligned}$$

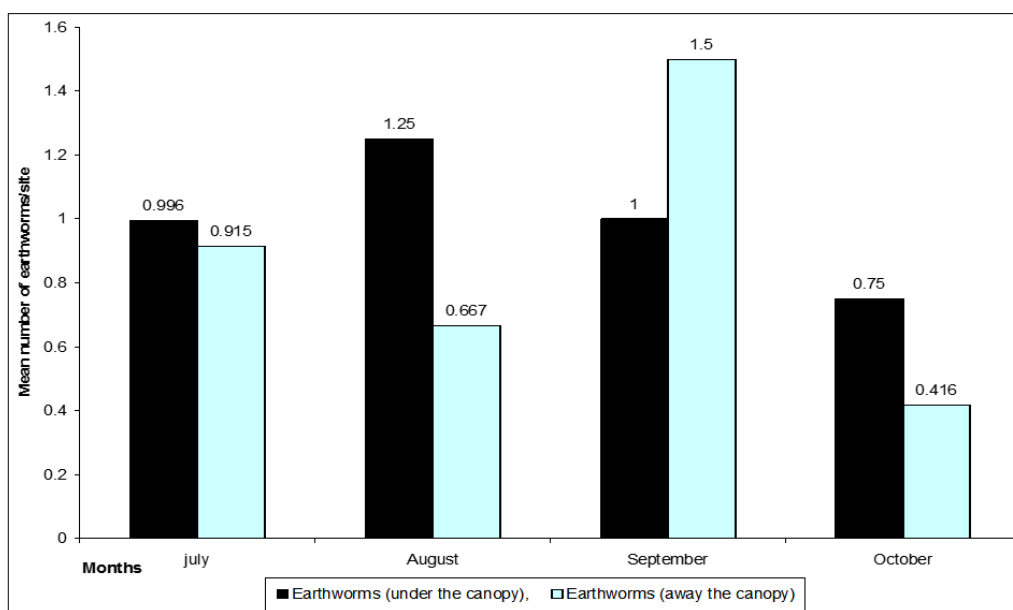


Fig 1: Abundance of earthworms under and away from the canopy in the field of mango

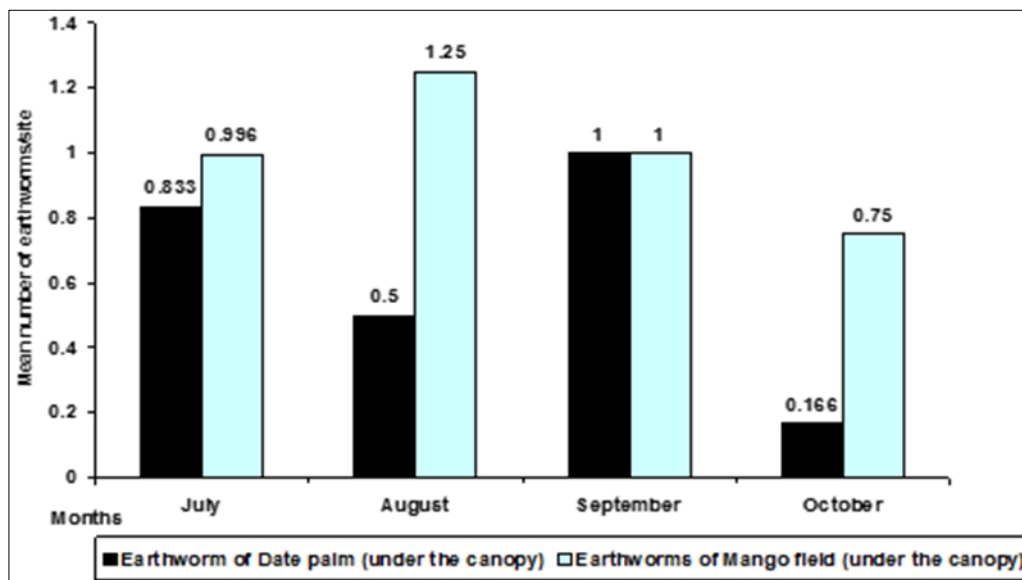


Fig 2: Population of earthworm under the canopy of Date palm and Mango

Discussion

Present study suggests that a positive relation is present between the mean number of earthworm and canopy of mango field except September. While no such relation was found in the date palm fields except in July where mean number of earthworm was higher (under the canopy). The canopy of mango trees were of larger diameter and less elevated from the ground while that of date palm trees it was of smaller diameter and more elevated from the ground. So these two canopies were compare able to sub shadow sites and open edge soils of fields. Thus the results of this study are in line with the findings of Sabahat (2005) who observed that sub shadow site harboured the highest number of earthworm specimens than the open edge soil of crop. Moreover the mean number of earthworm was the maximum in August and September and minimum in October under and away from the canopy in mango and date palm fields and *Pheretima posthuma* was the dominant species. Similar results were reported by Sabahat (2005) who stated that *Pheretima posthuma* is the most abundant species occurring through out the sampling period from June to November.

Conclusion

It is concluded from present research that the almost similar earthworm fauna is available under and away the canopy of Mango and Date palm

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