Impact of Organophosphate (Chloropyriphos) on Weight and Growth of Earthworm, *Eisenia foetida*

Santosh Pawar¹, Ahmad Shahezad²

¹Government Institute of Forensic Science, Nagpur-440001 (MS) India
²Government Vidarbha Institute of Science and Humanities, Amravati-444604 (MS) India

Abstract: Chloropyriphos is an organophosphate pesticide which is highly affected on earthworm’s life or population of earthworm. The objective of this work was to measure the impact of pesticide on earthworm, *Eisenia foetida*. For the experiment, earthworms were selected on the basis of developed clitellum and they were divided into six groups. Each group contained ten animals. First group as control group and bed was prepared in distilled water and remaining five groups were experimental groups and prepared single doses of 0.1, 0.2, 0.3, 0.4 and 0.5mg of Chloropyriphos for kilogram of dry soil for each set and exposed it for the duration of 7, 14, 21, 28 and 35 days. In the dose concentrations of 0.1and 0.2 were showed less effect on growth and weight of earthworm for the exposure period of 7 and 14 days, but at the 21, 28, and 35 days of exposure periods and doses concentration of 0.3, 0.4 and 0.5 were having more effects on weight and growth of worms.

Keyword: *Eisenia foetida*, Organophosphate, Growth, Weight, Body.

1. Introduction

Earthworms (Annelida) play important roles in growth of plant (Zambare et al., 2008). The earthworms give an important role in agriculture and food production. Among the organisms with their support activity in the filth, the earthworms are recognized for their significant role involving the betterment of physical and chemical features of land, and so increasing its fertility (Abdul Rida and Bouche, 1997). Soil is fundamental to the diverse communities of microbes, plants, and invertebrate and vertebrate animals that comprise the terrestrial ecosystem, and it is significant to consider the effects and hazards of polluted soil sites in relation to these ecological receptors (Ann et al., 1999). Pesticide applied to control, turf diseases or insect pests may severely affect earthworm. Malathion is considered one of the most abundantly used organophosphate pesticide, induced adverse effects in non-target organism like an earthworm (Wali et al., 1984). *Eisenia fetida* is the standard test organism used in terrestrial Ecotoxicology, because it can be easily bred on a variety of organic wastes with short generation times (ISO, 1993). Its susceptibility to chemicals resembles that of true soil organisms. Sensitivity tests of multiple earthworm species have revealed that *Eisenia fetida* is comparatively less sensitive (Fitzgerald et al., 1996).

Although many toxicity studies have been carried on, the fact remains that only a few pesticides in use have been tested against relatively few earthworm species, both in laboratory trials and under field conditions (Eijsackers, 2004). Chloropyrifos is generally used on grasses grown for seed to control billbugs (*Sphenophorus venatus confluens*) and cutworms (various species), and on other crops for cranefly larvae (Tipula spp.), garden symphyllans (*Scutigerella immaculata*), and wireworms (Agriotes spp.) (Fisher, et al., 2001; Rao, et al., 2000; Berry and Robinson, 1974).

2. Material and Methods

Earthworm, *Eisenia foetida* brought from Nursery Department of Forest, Amravati and adopted and acclimatized for one month as the test species, recommended by (OECD, 1984) guidelines for testing of chemicals no. 207, earthworm, acute toxicity tests. Adult earthworm which was having above 250-300mg of body weight with fully developed clitellum was used. Chloropyriphos as a test pesticide brought from commercial suppliers and a test solution was prepared in 1000ml in distilled water for the assessment of mortality. Four replicates were used for effects on mortality and it was measured by counting the number of worms alive after 14 days.

For the experiment, earthworms were divided into six groups. Each groups contained ten animals. First group as control group and bed was prepared in distilled water and remaining five groups were experimental groups and bed was prepared according to different doses of 0.1, 0.2, 0.3, 0.4 and 0.5mg of Chloropyriphos for kilogram of soil for each set and arranged it for the exposure duration of 7, 14, 21, 28 and 35 days. At the end of each experiment, we investigated the long term effects and results observed in treated animals at different concentration and duration of doses.

3. Results and Discussion

In the present study we observed that control groups showed increased weight and growth of worms than the treated groups. In the dose concentrations of 0.1and 0.2 were showed less effect on growth and weight of earthworm for the exposure period of 7 and 14 days, but at the 21, 28, and 35 days of exposure periods having more effects on weight and growth of worms. Similar effects were observed by Booth and O’Halloran where growth found to be significantly reduced in *A. caliginosa* by exposure to two OP pesticides, diazinon and chlorpyrifos, at 60 and 28 mg/kg.
doses (Booth and O’Halloran, 2001). These results showed a significant at 14 and 35 days of intoxication. Same result was also observed at 0.4 concentrations for 07 day exposure period, but in the 14 and 21and 35 days were showing more impact of pesticide on earthworm than the control. At the concentrations of 0.5 showed more effective on growth and weight of earthworms at all exposure periods of pesticide. Medium to high rates of the insecticide chlorpyrifos (OP) can cause mortality, dermal lesions, and reductions in activity of the common night crawler Lumbricus terrestris (Gavin et al., 2008). The change in biomass of earthworm (Eisenia fetida) was found to be dose-dependent during 28 days of exposure to dichlorovos (Sameena et al., 2011). Khan et al., (2007) reported a significant reduction in earthworm biomass after exposure to different concentrations of copper chloride and concluded that dysfunction of major physiological systems such as digestion and absorption with consequent disturbed metabolism resulted in biomass reduction.

The Organophosphate is widely used for the manufacturing of pesticide. But the pesticide is affects on target animal like earthworms which is farmer friend. We found that when a long term exposure of earthworm with a large quantity of pesticide results really harmful to growth and weight of earthworm. The quality of the substrate material used or fluctuating temperature is responsible for weight gain in E. eugeniae (Suthar, 2008). The short half-life of chlorpyrifos in the soil (Richardson and Gangollil, 1993) offers some disadvantages to growers trying to control target species, but may reduce the impact of this compound on non-target species. Singh et al., (2003) reported the significant contribution of soil microorganisms to the degradation of organophosphorus insecticides in natural soil.

Table 1: Impact of pesticide on earthworm at different concentrations and exposure periods

<table>
<thead>
<tr>
<th>Sample Conc./duration</th>
<th>Control</th>
<th>0.1 Conc.</th>
<th>0.2 Conc.</th>
<th>0.3 Conc.</th>
<th>0.4 Conc.</th>
<th>0.5 Conc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>7days</td>
<td>6.1±0.35</td>
<td>6.0±0.59</td>
<td>5±0.6</td>
<td>4.10±0.7</td>
<td>4.7±0.3*</td>
<td>5.0±0.7</td>
</tr>
<tr>
<td>14days</td>
<td>6.5±0.07</td>
<td>5.0±1.1*</td>
<td>5.2±0.4</td>
<td>4.0±0.8</td>
<td>4.2±0.7</td>
<td>4.8±0.8</td>
</tr>
<tr>
<td>21days</td>
<td>7.5±1.4</td>
<td>4.7±0.3</td>
<td>4.9±0.7</td>
<td>3.2±1.4</td>
<td>3.9±0.9</td>
<td>4.7±0.9</td>
</tr>
<tr>
<td>28days</td>
<td>7.9±1.62</td>
<td>4.0±0.8</td>
<td>3.4±1.5</td>
<td>3.1±1.4</td>
<td>3.4±1.2</td>
<td>4.9±0.7</td>
</tr>
<tr>
<td>35days</td>
<td>14.2±60</td>
<td>3.9±0.8*</td>
<td>3.8±1.4</td>
<td>3.5±1.2</td>
<td>3.7±1.06</td>
<td>4.0±1.4</td>
</tr>
</tbody>
</table>

Figure 1: Impact of pesticide on earthworm at different concentrations and exposure periods.

Figure 2: Experimental set of earthworm at different concentrations and exposure periods.

Investigated the long term effect and results were observed in treated animals at different concentration and duration of doses. A number of studies have been conducted on the standard worm Eisenia fetida/andrei. Zhou et al., (2006) have reported that the weight of the earthworms was a more sensitive index compared to the mortality in indicating toxic effects of acetochlor and methamidophos. Espinoza-Navarro and Bustos-Obregón, (2005) treated Eisenia fetida with organophosphate insecticide malathion and (Bustos-Obregón and Goicochea, 2002) explored the effect of exposure to
commercial parathion on Eisenia fetida; both observed decrease in the body weight of treated worms. Result of the present study was also shows similar effects. Weight loss appears to be a valuable indicator of physiological stress, related to the degree of intoxication and time of exposure (Frampton et al., 2006; Van Gestel, et al., 1995). Coiling, another symptom seen in 100% of the Parathion treated worms, is related with weight loss and is regarded as the consequence of alteration in muscular function elicited by organophosphoric pesticides which may explain the difficulties for locomotion of the intoxicated worms and their relative inability to feed themselves (Bustos-Obregón and Goicochea, 2002).

4. Conclusion

At the end conclude that the organophosphate (chloropyrophose) directly affects on growth and weight of earthworms. The present study results and supported reports suggested that the effect was dose and duration dependent, as we increased the concentrations of pesticide and durations of exposure period that adversely affects on worms. Therefore, the result suggests that the organophosphate (chloropyrophose) targets to non-target soil organism.

5. Future Scope

Use of fertilizer pose a serious threat to fertile nature of soil. This effect due to disturb diversity and numbers of earthworms in soil. Population of worms declines only due to continuous use of fertilizers by the farmers. Therefore, this study will provide scientific data regarding to choose appropriate quantity of fertilizers for the control of pests as well as does not harm to non target recipients like earthworms in soil. Population of worms declines only due to continuous use of fertilizers by the farmers. Therefore, this study will provide scientific data regarding to choose appropriate quantity of fertilizers for the control of pests as well as does not harm to non target recipients like earthworms, is related with weight loss and is regarded as the consequence of alteration in muscular function elicited by organophospheric pesticides which may explain the difficulties for locomotion of the intoxicated worms and their relative inability to feed themselves (Bustos-Obregón and Goicochea, 2002).

References


**Author Profile**

**Dr. Santosh Shivlal Pawar** is Associate Professor in Zoology and Head, Department of Forensic Biology, Government Institute of Forensic Science, R.T Road, Civil Lines, Nagpur,-440001 Maharashtra State, India. He has done B. Sc., M. Sc. and Ph. D in Zoology form Govt. Vidarbha Institute of Science and Humanities, Amravati, Maharashtra, India. He has 12 years Teaching Experience. Presently he is working at Government Institute of Forensic Science, Nagpur, Maharashtra, India. His research interests include Biodiversity, Toxicology, Forensic Entomology and Population Genetics.

**Ahmad Shahezad** is a Research Student, Department of Zoology, Government Vidarbha Institute of Science and Humanities, Amravati. He has done B. Sc., M. Sc (Zoology) from Vidya Bharti Mahavidyalaya, Amravati, with Animal Physiology Specialization. B. Ed from Nagpur, Maharashtra, India. Presently he is working as a CHB Teacher at Govt. Vidharbha Institute of Science and Humanities, Amravati, Maharashtra, India.