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

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Abstract: ***Chloropyriphose 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 groups 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, 04 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). Chlorpyrifos is generally used on grasses grown for seed to control billbugs (*Sphenophorus venatus confluens*) and cutworms (various species), and on other crops for crane fly larvae (Tipula spp.), garden symphyllans (*Scutigerella immaculate*), 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 foetida*) 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

Sample Conc./ duration	Control	0.1 Conc.	0.2 Conc.	0.3 Conc.	0.4 Conc.	0.5 Conc.
7days	6.1±0.35	6.0±0.59	5±0.6	4.10±0.7	4.7±0.3*	5.0±0.7
14days	6.5±0.07	5±0.11*	5.2±0.4	4.0±0.8	4.2±0.7	4.8±0.8
21days	7.58±1.4	4.7±0.3	4.9±0.7	3.2±1.4	3.9±0.9	4.7±0.9
28days	7.9±1.62	4.0±0.8	3.4±1.5	3.1±1.4	3.4±1.2	4.9±0.7
35days	14.2±60	3.9±0.8*	3.8±1.4	3.5±1.2	3.7±1.06	4.0±1.4

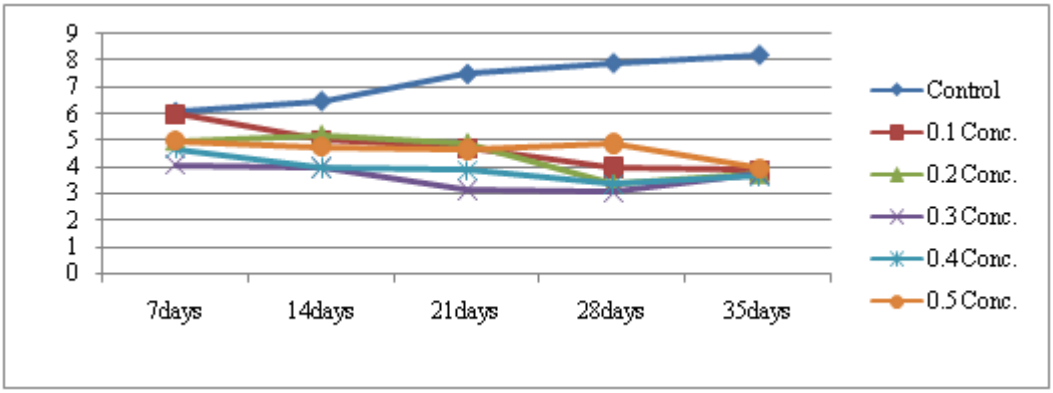

Figure 1: Impact of pesticide on earthworm at different concentrations and exposure periods.

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 fertilize 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 earthworm and for the healthy diversity of soil.

References

[1] Abdul Rida A. M. and M. B. Bouché (1997) Soil Biology and Biochemistry, 29: 699
[2] Ann Y., Reddy K. R. and J. J. Delfino (1999) Influence of chemical amendments on phosphorus retention in a constructed wetland. Ecol. Eng. 14:213.
[3] Berry R. E. and R.R. Robinson (1974) Biology and control of the garden symphylan. Oregeon State University Extension Service, Extension Circular 845: 1-11.
[4] Booth L. H. and K. A. O'Halloran (2001) Comparison of biomarker responses in the earthworm Aporrectodea caliginosa to the organophosphorus insecticides diazinon and chlorpyrifos. Environmental toxicology and chemistry. 20 (11):2494-502.
[5] Bustos-Obregón and R. I. Goicochea (2002) Pesticide soil contamination mainly affects earthworm male reproductive parameters, *Asian Journal of Andrology*, Vol. 4(3):195–199.
[6] Eijsackers (2004) Earthworms in environmental research. In Earthworm Ecology, 2nd ed. Clive A. Edwards (ed.):321-342.
[7] Espinoza-Navarro and E. Bustos-Obregón (2005) Effect of malathion on the male reproductive organs of earthworms, *Eisenia foetida*, *Asian Journal of Andrology*, Vol. 7(1): 97–101.
[8] Fisher G. C., J. T. DeFrancesca and S.U. Rao (2001) Evaluation of insecticides for control of western orchardgrass billbug. In W.C. Young III (ed.), Seed Production Research, Oregon State Univ., Ext/CrS 121, 4/02.
[9] Fitzgerald D. G., Warner, K. A., Lanno R. P. and D. G. Dixon (1996) Assessing the effects of modifying factors on pentachlorophe- no toxicity to earthworms: applications of body residues, *Environmental Toxicology and Chemistry*, Vol. 15(12): 2299–2304.
[10] Frampton G. K., Jänsch S., Scott-Fordsmand J. J., Römbke J. and P. J. Van den Brink (2006) Effects of pesticides on soil invertebrates in laboratory studies: a review and analysis using species sensitivity distributions, *Environmental Toxicology and Chemistry*,Vol. 25(9):2480–2489.
[11] Gavin W. E., Banowetz G. M., Griffith S.M., Mueller-Warrant G.W. and G.W. Whittaker (2008) Seed Production Research At Oregon State University USDA-ARS Coopereting Edited by William C. Young III Department of Crop and Soil Science Ext/CrS 128, 3/09.
[12] ISO (1993) "Soil quality—effects of pollutants on earthworms (Eise- Nia fetida) —part 1: determination of acute toxicity using artificial soil substrate," ISO 11268-1, International Organization for Standardization, Geneva, Switzerland.
[13] Khan Iram, Ayesha S. and A. Sharique (2007) Biomass and behavioral responses of earthwotm, Lumbricus terrestris to copper chloride. *Iranian Journal of Toxicology*, 1(2).
[14] Mueller D. C., Bonner J. S., McDonald S. J. and R. L Autenrieth (1999) 'Acute toxicity of estuarine wetland sediments contaminated by petroleum, Environ. Techn., 20:875-882
[15] OECD (1984) 'Earthworm, acute toxicity tests', OECD Guideline for Testing of Chemicals 207, OECD, Paris, 1–9.
[16] Rao T. S. U., Fisher G. C. and L. A. Royce. (2000) Crane flies and emerging pest complex in grass seed fields. In W.C. Young III (ed.), Seed Production Research, Oregon State Univ., Ext/CrS 115, 4/01.
[17] Richardson M. L. and S. Gangollil (1993) The dictionary of substances and their effects, vol. 2C. Royal Society of Chemistry, London, U.K.
[18] Sameena Farrukh and Ayesha S. Ali (2011) Effects of Dichlorovos Organophosphate on Growth, Reproduction, and Avoidance Behavior of Earthworm *Eisenia foetida*. *Iranian Journal of Toxicology* Vol. 5(14): 496-501.
[19] Singh B. K., Walker A, Morgan J. A.W and D. J. Wright (2003) Effects of soil pH on the biodegradation of chlorpyrifos and isolation of a chlorpyrifosdegrading bacterium. *Applied and Environmental Microbiology*, 69(9):5198.
[20] Suthar S. (2008) Bioconversion of post harvest crop residues and cattle shed manure into value added products using earthworm *Eudrilus eugeniae* Kinberg. Ecol. Eng. 32:206-214.
[21] Van Gestel A. M., Zaal J., Dirven-Van Breemen E. M. and R. Baerselman (1995) Comparison of two test methods for determining the effects of pesticides on

earthworm reproduction, *Acta Zoologica Fennica*, Vol. 196: 278–283.
[22] Walli R. K., Singh R., Dudeja P. K., Sarkar A. K. and A. Mahmood (1984) Subchronic Malathion treatment effects on rat intestinal functions. Bull. Environ. Contam. Toxicol. 33: 289-294.
[23] Zambare VP, Padul MV, Yadav AA and Shete TB, (2008) J. Agric. Biol. Sci., 3(4):1-5.
[24] Zhou X., Zhang Q. R. and J. D. Liang (2006) Toxic effects of acetochlor and methamidophos on earthworm *Eisenia fetida* in phaiozem, northeast China, *Journal of Environmental Sciences*, Vol. 18(4):741–745, 2006.

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