Vol 4 | Issue 3| 2014 | 143-146.

International Journal
of
Pharmacy Review & Research
www.ijprr.com

e-ISSN: 2248 – 9207
Print ISSN: 2248 – 9193

A REVIEW OF STUDIES PERFORMED TO ASSESS PESTICIDE POLLUTION BY EARTHWORM'S GROWTH

B.Govindarajan*

Department of Zoology, VHNSN College (Autonomous), Virudhunagar-626001, Tamilnadu, India.

ABSTRACT

Pesticides use affects the human health, soil ecosystems and atmosphere vicinity. It is possible to find examples where pesticides have impacted on soil non-target organisms mainly soil invertebrates. Earthworms play a important role in soil system. The pesticides effect on non-target soil organisms, particularly those affecting the very familiar farmer's friend earthworm. Several research studies have reported different types of malformations of earthworm's growth in response to exposure to chemicals. In this review paper, we examine what can currently be surmised about the direct and indirect long-term, field impacts of pesticides upon the earthworm growth.

Key words: Pesticides, Earthworms.

INTRODUCTION

The world population is expected to reach 9.1 billion by the year 2050 with the current annual growth rate of 1.2% [1]. Increasing agricultural activities for food security is very important. The increasing uses of agrochemicals such systems affects non-target organisms in soil and water [2]. Earthworm is an important tool to evaluate different environmental transformations and pollution impacts. Agricultural field, urban and industrialized vicinity have some earthworms that represent interesting indicators to monitor different pollutants, to assess different farming practices and different landscape structures and transformations.

Use of earthworm in toxicology studies is very common. This type studies were focused on growth, reproduction potential, avoidance behavior and mortality. This review paper presents a comprehensive overview of the impacts of pesticides use and provides some more information as to what are the impacts in earthworm in modern agriculture.

Current usage of pesticides in agricultural field

Continuous usage of pesticides causes a lot of problems in ecosystem. The World Health Organization (WHO) has estimated that some 20,000 people die annually from pesticide exposure [3] but those chemicals also protect yields, profits and public health. Several studies have reported different types of malformations of earthworms in response to exposure to chemicals.

Animal selection

Earthworms play key roles in soil ecosystem. They are considered not only composting agents and biofertilizers but also soil aerators, soil moisture retainers and biological agents. Earthworms can be used as bio-indicators to detect pesticide contamination in soils [4].

Direct effect of pesticide on soil non-target organisms

The current style of agriculture methods have demonstrably led to extensive and permanent loss of biodiversity in ecosystem (for soil invertebrate communities, [5] and for farmland birds in Europe, see [6]). The agricultural chemicals (pesticides, heavy metals, poly chlorinated biphenyls, polymers and acid precipitations) that reach the soils include. The pesticides poisoning events on non-target soil organisms, particularly those affecting very familiar earthworm. Growth of earthworms was related directly to the quality of the feed. Insecticides have been shown to devastate natural enemy to earthworm populations in some ecosystems [7].

Several other environmental-factors also affect the influence of pesticides on earthworms. These include

*Corresponding Author: B. Govindarajan E mail: bgrmphilbed@gmail.com

The route of exposure, water solubility, volatility, adsorption capacity, moisture content, proportions and amount of clay and organic matter in the soil, pH, temperature and persistence in soil ecosystem.

Effects of pesticides on earthworms

Previously studied the *L. terrestris* is often exposed to a high concentration of pesticides because this species moves over and feeds at the soil surface. *A. caliginosa* also lives in the superficial layers of the soil and the adults may move over the soil surface, thereby becoming particularly vulnerable to surface pesticide residues. *Aporrectodea longa*, on the other hand, seems to be less susceptible to pesticides than many other species of earthworm because it can burrow deep into the soil and also usually enters an obligatory diapause in adverse conditions [8].

There is an extensive literature on the effects of pesticides on earthworms [9]; [10] and [11]. Workers such as earlier authors [12] have tested a range of pesticides and other chemicals for their toxicity to earthworms and concluded that different chemicals and pesticides vary greatly in their degree of toxicity to the earthworms. [13] Earlier author also mentioned that chiordane, heptachior, aldrin, dieldrin, telodrin, DDT and carbaryl are toxic to earthworms.

Aldicarb (Pesticide) was the toxic to earthworm (*Allolobophora caliginosa, A. chlorotica* and *Lumbricus rubellus*) species, causing severe dehydration prior to death or at sublethal concentrations. Carbaryl and carbofuran pesticides lethal to *A. caliginosa, A. chlorotica* and *L. rubellus*. Paraoxon, parathion, trichloronate and gamma-HCH were having the impact to all species [14].

Insecticides effects on earthworms

A number of studies have been conducted on the standard worm *Eisenia fetida/andrei*. Basically, many researchers agree that organophosphate insecticides such as chlorfenvinphos, disulfoton and dyfonate are toxic to earthworms. Parathion, ethopropos and fonfos are all proved to be moderately toxic to earthworms. Earlier author [15] reported phorate was extremely toxic to earthworms and has almost eliminated earthworms from many soils, even at normal agricultural rates. Earlier author [16] studied the monocrotophos insecticide effect on earthworm growth, reproduction potential and mortality of earthworms.

Many carbamate insecticides and fungicides strongly affect populations of earthworms. Other carbamate insecticides tested for toxicity to earthworms, high toxicity has been reported for aminocarb, methiocarb, oxamyl and promecarb and very high toxicity for aldicarb, bufencarb, carbaryl, carbofuran, methomyl, propoxur and thiofanox. Previous studies [10] [17] also suggested that majority of the carbamate pesticides are toxic to earthworms. The organophosphate insecticides phosphamidon, monocrotophos and dichiorvos all inhibited acetylcholinesterase activity in earthworms [18].

Some of the responses of earthworms to sublethal concentrations of pesticides. [19] Earlier author reported that the body weight of the earthworms was a more sensitive index compared to the mortality in indicating toxic effects of acetochlor and methamidophos. [20] treated *Eisenia fetida* with organophosphate insecticide malathion and earlier author [21] explored the effect of exposure to commercial parathion on *E. fetida;* both observed decrease in the body weight of treated earthworms.

Previous studies found endosulfan did reduce the weight of juvenile *Aporrectodea trapezoides* within 5 weeks when applied to soil at normal application rate in both the field and laboratory. Both fenamiphos and methiocarb reduced earthworm weight in the laboratory condition. Body weight loss appears to be a valuable indicator of physiological stress, related to the degree of intoxication and time of exposure. Coiling, another symptom seen in 100% of the Parathion treated worms, is related with weight loss and is regarded as the consequence of alteration inmuscular function elicited by organophosphoric pesticides which may explain the difficulties for locomotion of the intoxicated worms and their relative inability to feed themselves [21,22].

Negative impact of pesticides on earthworm growth has been reported by various researchers. [23] suggested that growth can be regarded as sensitive parameters to evaluate the toxicity of acetochlor on earthworms. [24] tested in laboratory the effect of copper oxychloride, while earlier authors [25] investigated the impact of carbendazim, glyphosate and dimethoate on *Eisenia fetida* and found a significant reduction in the earthworm growth in a dose-dependent manner. According to [26] parathion affects the growth of *Eisenia andrei*.

Previously studied the effect of two organophosphates, chlorpyrifos and diazinon, while [28] investigated the toxicity of aldicarb, cypermethrin, profenofos, chlorfluazuron, atrazine and metalaxyl in the earthworm *Aporrectodea caliginosa* and observed a reduction in growth rate in all pesticide-treated worms [27].

Previously reported the effects of endosulfan and aldicarb on *Lumbricus terrestris* and have suggested growth rate as important biomarkers for contamination by endosulfan and aldicarb [28,30] assessed and found chlorpyrifos had adverse effect on growth potential in earthworm exposed to 5 mg/kg chlorpyrifos after eight weeks. Some studies have shown that growth of earthworms appeared to be more severely affected at juvenile stage than at adult stage [31].

A single application of the insecticides ethoprop and carbaryl at labeled rates reduced earthworm populations by 60- 99%, with significant effects lasting for at least 20 wk [32].

Herbicides effect on earthworms

Previous studies [33] explained herbicides are also directly toxic to earthworms. However, it is probable that they may exert considerable indirect effects due to their influence on weeds as a source of supply of organic

matter on which earthworms feed in soil. Reports from many research works show that chloroform, profam, dinoseb and triazine herbicides such as simazine have moderate effects on earthworm populations. Earlier author [34] also reported take up and metabolism of some herbicides by earthworms. Herbicides tested significantly affected earthworm populations [32].

Fungicides effect on earthworms

Copper-based fungicides in orchards completely eradicated earthworms. For instance, [35] earlier author pointed out that the fungicide benomyl had effects on the posterior segment regeneration of the earthworm *Eisenia fetida*. The effects also include an increased frequency of segmental groove anomalies and many monstrosities. [36] exposed earthworms to carbamates and observed that carbamates can cause tumors and swellings along the earthworm's body.

Weight loss has also been reported for organochlorine pesticides intoxication and for the effects of fungicides and herbicides in *Eisenia fetida* and *Lumbricus terrestris*. Fumigant nematicides and fungicides such as D-D mixture, metham sodium and methyl bromide are normally applied to the soil to control pathogens and nematodes. However, most of these chemicals are broad-spectrum biocides and penetrate the soil as vapors and kill most of the earthworms, even those that live in deep burrows [15]. Chloropicrin and the contact nematicide methomyl are also very toxic to earthworms, and it seems there is little doubt that the majority of fumigant and contact nematicides are toxic to earthworms. A single application of the fungicide benomyl application reduced the earthworm populations by 60- 99%, with significant effects lasting for at least 20 wk [32].

Impact of fertilizers on earthworms

It has clearly been established that organic fertilizers affect number of earthworms in soil, but there had been fewer studies of the influence of inorganic fertilizers on earthworm populations. The effect of fertilizers on earthworms may be direct, for instance, by changing the acidity of the soil, or indirectly, by changing the form and quantity of the vegetation that ultimately provides food for worms.

Previously reviewed [12] the symptoms caused by 23 pesticides to earthworms and reported that the most common reaction to chemicals was coiling of the body and longitudinal muscle contraction, after which the body became rigid and sometimes swellings appeared on the body surface. The swellings often burst creating bleeding sores [37]. Previous studies [4] also mentioned the same symptoms occurred when the earthworms are treated with propoxur, methidathion, endosulfan, triazophos, carbofuran, terbufos and methamidophos. Aldicarb, endosulfan, benomyl and calcium cyanide also caused constrictions of the body to occur, according to the authors.

CONCLUSION

The usage of pesticides (insecticides, herbicides, fungicides, etc) in agricultural field is affecting the all type of ecosystems. So instead of the pesticides please go to the vermiwash (earthworm body fluid). We recommended the conversion of municipal solid waste into compost through earthworms. It may be give effective result in municipal solid waste recycling in side compost used as a fertilizer. For the safeguard management farmers simply go to vermicompost and vermiwash.

ACKNOWLEDGEMENTS

The authors heartily thankful to the Mr.S.Sathananthan, Managing Director, Dr.BGR Pollution Management Research Institute, Surandai-627859, Thirunelvelli-(Dt).

REFERENCES

1. Cohen JE. Human population grows up. *Sci Am*, 293, 2005, 48-55.
2. Reinecke SA and Reinecke AJ. The impact of organophosphate pesticides in orchards on earthworms in the Western Cape, South Africa. *Ecotoxicol Environ Safety*, 66, 2007, 244-251.
3. WHO (World Health Organization) WHO, Public Health Impact of Pesticides Used in Agriculture. Geneva, World Health Organization, 1990.
4. Stenersen J, Gilman A and Vardanis A. Carbofuran, Its toxicity to and metabolism by earthworm (*L. terrestris*). *J Agr Food Chem*, 21, 1973, 1973-1977.
5. Heaney SI, Foy RH, Kennedy GJA, Crozier WW and Connor WCK. Impacts of agriculture on aquatic systems, lessons learnt and new unknowns in Northern Ireland. *Marine and Freshwater Res*, 52(1), 2001, 151–163.
6. Donald PF, Green RE and Heath MF. Agricultural intensification and the collapse of Europe's arml and bird populations. *Pro. the Royal Society of London, Series B, Biological Sciences*, 268, 2001, 25–29.
7. Boza Barducci T. Ecological consequences of pesticides used for the control of cotton insects in the an˜ete Valley, Peru. In M. T. Farvar and J. P. Milton (eds.), The Careless Technology, Ecology and Int. development, Garden City, New York, The Natural History Press, 1972.
8. Edwards CA and Lofty JR. Effects of insecticides on soil invertebrates. *Rep Rothamsted Exp Stn*. For, 1971.
9. Thompson AR and Edwards CA. Effects of pesticides on non-target invertebrates in freshwater and soil. In, Pesticides in soil and water, 1974, 341-386. (Guezi, S., ed.) Soil Sci. Am.,Wisconsin.
10. Dean-Ross D. Methods for the assessment of toxicity of environmental chemicals to earthworms. *Regul Toxicol Pharmaclo*, 3, 1983, 48-59.
11. Edwards CA and Neuhauser EF. Earthworms in waste and Environmental Management. *SPB Academic Publication*, the Hauge. 1989

12. Haque A and Ebing W. Toxicity determination of pesticides to earthworms in the soil substrate. *J Plant Diseases & Protection*, 90(4), 1983, 395–408.
13. Thompson AR. Effects of nine insectides on the numbers and biomass of earthworms in pasture. *Bull Environ Contam Toxicol*, 5(6), 1971, 577-586.
14. Jørgen Stenersen. Action of pesticides on earthworms. Part I, The toxicity of cholinesterase-inhibiting insecticides to earthworms as evaluated by laboratory tests, 10(1), 1979, 66–74.
15. Edwards CA and Bohlen PJ. Biology and ecology of earthworms. Third ed. Chapman and Hall, London, 1996.
16. Govindarajan B and Prabaharan V. Monitoring of soil insecticide (monocrotophos) pollution by *Eisenia fetida*. *J Biosci Res*, 3(1), 2012, 58-61.
17. Haque A and Ebing W Toxicity determination of pesticides to earthworms in the soil substrate. *J Plant Diseases and Protection*, 90(4), 1983, 395–408.
18. Bharathi C and Rao SBV. Toxicity of phosphoamidon to the common South Indian earthworm, *Lampito mauritti*. *Bull Environ Contam Toxicol*, 32, 1984, 295-300.
19. Zhou QZ, Zhang QR and Liang JD. Toxic effects of acetochlor and methamidophos on earthworm *Eisenia fetida* in phaiozem, northeast China. *J Environ Sci*, 18(4), 2006, 741–745.
20. Espinoza-Navarro O and Bustos-Obregon E. Effect of malathion on the male reproductive organs of earthworms, *Eisenia foetida*. *Asian J Andrology*, 7(1), 2005, 97–101
21. Bustos-Obregon E and Goicochea RI. Pesticide soil contamination mainly affects earthworm male reproductive parameters. *Asian J Andrology*, 4(3), 2002, 195–199.
22. Choo LPD and Baker GH. Influence of four commonly used pesticides on the survival, growth, and reproduction of the earthworm *Aporrectodea trapezoides* (Lumbricidae). *Australian J Agricultural Res*, 49(8), 1998, 1297–1303.
23. Xiao N, Jing B and Liu X. The fate of herbicide acetoclor and its toxicity to *Eisenia fetida* under laboratory conditions. *Chemosphere*, 62(8), 2006, 1366-1373.
24. Yasmin S and Souza D. Effect of pesticides on the reproductive output of *Eisenia fetida*. Bulletin of Environ. *Contamination & Toxicol*, 79(5), 2007, 529–532.
25. Van Gestel CAM, Dirven-Van Breemen EM and Baerselman R. Comparison of sublethal and lethal criteria for nine different chemicals in standardized toxicity tests using the earthworm *Eisenia andrei*. *Ecotoxicol & Environ. Safety*, 23(2), 1992, 206–220.
26. Booth LH, Heelthwaite VJ and Ohaloran K. Growth, development and fecundity of the earthworm *Aporrectodea calisinosa* after exposure to two organophosphates. *New Zealand Plant Protection*, 53, 2000, 221-225.
27. Mosleh YY, Ismail SMM, Ahmed MT and Ahmed YM Comparative toxicity and biochemical responses of certain pesticides to the mature earthworm *Aporrectodea caliginosa* under laboratory conditions. *Environ Toxicol*, 18(5), 2003, 338–346.
28. Mosleh YY, Paris-Palacios S, Couderchet M and Vernet G Biological effects of two insecticides on earthworms (*Lumbricus terrestris* L.) under laboratory conditions. Mededelingen Rijksuniversiteit te Gent. Fakulteit van de Landbouwkundige en Toegepaste. *Biologische Wetenschaen*, 67(2), 2002, 59–68.
29. Zhou SP, Duan CQ, Fu H, Chen YH, Wang XH and Yu ZF Toxicity assessment for chlorpyrifos-contaminated soil with three different earthworm test methods. *J Environ Sci*, 19(7), 2007, 854–858.
30. Zhou S, Duan C, Wang X, Michelle WHG, Yu Z and Fu H Assessing cypermethrin-contaminated soil with three different earthworm test methods. *J Environ Sci*, 20(11), 2008, 1381–1385.
31. Potter, Daniel A, Buxton, Margaret C, Redmond, Carl T, Patterson, Cary G, Powelu and Andrew J. Toxicity of Pesticides to Earthworms (Oligochaeta, Lumbricidae) and Effect on Thatch Degradation in Kentucky Bluegrass Turf. *J. Economic Entomology*, 83(6), 1990, 2362-2369.
32. Edwards CA. Impact of herbicides on soil ecosystems. *Grit Rev Plant Sci*, 8, 1989, 221-257.
33. Reinecke AJ and Nash RG. Toxicity of 2,3,7,8 TcDD and short term bioaccumulation by earthworms (Oilgochaeta). *Soil Biol Biochem*, 16, 1984, 96-100.
34. Zoran MJ, Hener TJ and Drewes CD. Teratogenic effects of the fungicide benomyl on posterior segmental regeneration the earthworm *Eisenia fetida*. *Pestic Sci*, 17, 1986, 641-653.
35. Anton F, Laborda E and Laborda P. Acute toxicity of the fungicide capton to earthworm *Eisenia fetida*. *Bull Environ Contam Toxicol*, 45, 1990, 82-87.