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Human Health and Environmental Effects of Pesticide Use in Agriculture

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Abstract: ***The large scale and injudicious use of pesticides has created alarming concerns about the adverse effects on human health and the environment. The non target organisms, particularly insect's natural enemies and pollinators, have got the most attention about the adverse effects of pesticides because of their value in integrated pest management (IPM) and pollination processes, respectively. Because Natural enemies play an important role in controlling pest population levels, therefore, destruction of these by using pesticides can activate pest problems. The secondary pest outbreaks are also caused by the loss of predator species. Because of indiscriminate use of pesticides in agriculture the quality of soil and aquatic environment are also adversely affected to the considerable level along with the natural enemies. Pesticides degrade soil invertebrates including earthworms, nematodes and other small organisms that have an important role in soil ecosystem. Pesticides can pass in to the human body through inhalation, oral or dermal exposure and become the main cause of several diseases like cancer, respiratory diseases, skin diseases, endocrine disruption and reproduction disorders. There are various ways to protect human health and environmental hazards as a result of indiscriminate use of pesticides in agriculture like, development and use of safe and environmental friendly pesticide formulations, introduction of alternative pest control master plans in an IPM approach such as host plant resistance and bio control.***

Keywords: Pesticide exposure, Health effect of pesticides, Pesticide effect on aquatic environment

I. INTRODUCTION

Two major concerns in fast growing human population throughout the world are environmental safety and food security. Serious damage caused by pests in agriculture in terms of productivity and high price of chemicals that costs a huge price annually and increases the agricultural production budget. Despite of these, the widespread use of chemical pesticides has been preferred due to the benefits they got in agriculture, especially by protecting crops from pest damage and increase the productivity. But on the other side the use of these pesticides causes a serious threat to the environment and human health. Farmers are at a high risk of exposure to pesticides those directly involved in the handling of pesticides during mixing and spraying pesticides or while working in the treated fields and from residues on food and drinking water. Sometimes due to lack of knowledge farmers face great risks of exposure particularly when they use toxic chemicals that are banned, incorrect method of applications, poorly maintained or totally inappropriate spraying equipment and often the reuse of pesticide containers for food storage, poor use of personal protection equipment(PPE) and other safety measures. There are various type of human health problems directly related to related with use of pesticides, ranging from short term impacts like headaches and nausea to chronic impacts like various types of cancers, endocrine disruption infertility, and birth effects. Children, in particular are more susceptible to pesticide exposure. Furthermore, injudicious use of pesticides may lead to the destruction of non target species, destruction of biodiversity and also lead to contamination of soil, water, and air. Therefore this review work is focused on the hazardous effect of chemical pesticides on human health and the environment.

II. EFFECT OF PESTICIDE ON INSECT NATURAL ENEMIES

The organisms that play a very important role in keeping the pest populations under control are the predators, they remain alive by preying on other organisms. Predators are also considered to be an important part of the biological control approach, which is one component of integrated pest management. For the achievement of an integrated pest management (IPM) program, the integration of chemical and biological control is very important. Under the following circumstances predators can be exposed to insecticides: by direct contact with spray droplets; by taking residues when contacting with contaminated surfaces; by feeding on contaminated food like honeydew, host or nectar with the pesticides. There are many investigations that revealed the side effects of pesticides on predators and showed that pesticides were the main cause for decline in predator population. For example Vostrel (1991) stated that most of times tested fungicide, acaricides, insecticides (carbamates & synthetic pyrethroids), have negative effects to varying degrees on all stages of Coccinella septempunctata.

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From toxicity of five insecticides (tebufenozide, flufenoxuron, phosalon, deltamethrin and *Bacillus thuringiensis*) on predatory mites (Acari: Phytoseiidae), the results showed that phosalon and deltamethrin had poor selectivity on the phytoseiidae mites, *Bacillus thuringiensis*, tebufenozide and flufenoxuron showed good selectivity to these predators . The toxicity of Spinosad to *Chrysoperla carnea* and its effect on the reproduction and survival of adult stages after direct spray and ingestion treatments show that Spinosad was harmless to *Chrysoperla carnea* eggs and pupae irrespective of concentrations or method of treatments. Predator behavior and their life-history parameters including growth rate, development time, and other reproductive functions can also be affected by pesticides.For example,

Evant et al. demonstrated that glyphosate-based herbicides have the adverse effect on the behavior and survival of spiders and ground beetles in the eastern USA. Similarly Giglio et al. showed that the effect of dimethoate on carabid beetle *Pterostichus melas italicus* and found significant decrease in haemocyte counts, the body size, and reduction of morph metric parameters. Any insecticide sprays are toxic to most parasitoids; however, there may be sub lethal effects on the rate of parasitism, host feeding and foraging efficiency. For example *Thrichogramma brassicae* (Bezdenko) males treated with low doses of the insecticide deltamethrin did not respond to the female signals while the females treated with these insecticides also showed the reduced capacity of attracting untreated males of this parasitoid. Effect of some pesticides on parasitoids is listed in table below:

Effect of some pesticides on parasitoids

Pesticide	Parasitoide	Effect
Acetamiprid	*Diadegma insulare; Oomyzus sokolowski; Trichogramma japonicum*	Slightly harmful to adults
Indoxacarb	*Encarsia formosa* *Trichogramma chilonis*	Harmful to adults *moderately* harmful to Larva, pupa and adult
Thiacloprid	*Encarsia formosa*	Harmful
Imidacloprid	*Hyposoter didymator; Trichogramma japonicum*	Somewhat harmful to adults and harmless to larvae
Fipronil	*Cotesia plutellae, Oomyzus sokolowski;*	Reasonably Harmful to adults
Chlorantraniliprole	Chlorantraniliprole *Trichogramma japonicum; Cotesia chilonis*	Harmless to adult
Pymetrozine	*Hyposoter didymato*	Slightly harmful to adult
Spiromesifen	*Eretmocerus mundus* and *Orius laevigatus*	Harmless to adults
Formamidines (Amitraz)	*Cales noacki; Encarsia formosa*	Moderately harmful

III. PESTICIDE EFFECT ON HUMAN HEALTH

Pesticides poisoning is a global public health problem and large number of deaths occur worldwide every year due to pesticide poisoning. Different cases of acute and chronic poisoning occur, worldwide due to pesticide poisoning, with effects of varying hazard on human health, from mild effects to death. Every year about two to three million case of acute pesticide poisoning occur worldwide .Out of these three million cases of pesticide poisoning, two million are suicide attempts, and the rest are due to accidental or occupational poisoning. Generally people become the victim of pesticide poisoning when they get exposure to pesticides while preparing the spray solutions, loading the pesticide solutions in the spray tank and while applying the pesticide in their fields. Continuous exposure of pesticides for a long period of time, may lead to chronic illnesses in humans.

At the later stage of age symptoms of the chronic diseases are manifested. Magnitude of such health disorders are dependents upon individual susceptibility, the kind of the substance and it's dose received and route of exposure such as inhalation, ingestion or skin absorption. Several studies have shown that the chronic diseases like cancers, fertility problems, depression, diabetes, respiratory diseases, and neurological disorders occur due to use of pesticides. Epidemiological studies in humans indicated that the second most common cancer in men, after lung cancer is the prostate cancer found mostly in male farm workers of age above 50 years, due to the use of chlorinated pesticides and methyl bromide.

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From the study conducted in various countries on the dermo respiratory symptoms induced by pesticide use shown that most of the farmers due to lack of knowledge about the pesticides use heavy pesticides. These farmers had a very high chance of getting chronic dermo-respiratory symptoms, particularly cough, pharyngitis, bronchitis, asthma, breathing insufficiency, sinusitis, pharyngeal irritation, nasal irritation, eye irritations and contact dermatitis. Several health problems such as Parkinson's disease, disruption of blood glucose level have been linked with pesticides induced oxidative stress.

Some chronic diseases caused by pesticide exposure

Name of Disease	Pesticide Name
Cancer (breast cancer, bone cancer, leukaemia; brain; prostate cancer; breast cancer etc.)	Atrazine, endosulfan, metolachlor, simazine, malathion,carbaryl etc.
Respiratory problems (asthama)	Carbamate and Organophosphate
Endocrine disrupting effects	Chlorpyrifos, Diuron, Imidacloprid, Malathion, Simazine, Paraquat, Atrazine.
Birth defects (circulatory, musculoskeletal, respiratory, and urogenital, congenital defects of heart, eye, face and brain)	oxydemeton-methyl , Atrazine, trifluralin.
Immune system effects caused by some pesticides	Imidacloprid , Ametryn , Chlorpyrifos, Diuron, glyphosate, paraquat, simazine, Atrazine.

IV. PESTICIDE EFFECT ON SOIL ENVIRONMENT

Extensive use of pesticides in agriculture can degrade and cause adverse effect to the microorganism community living in the soil. Studies have shown that pesticides have an adverse effect on soil microorganism, soil enzyme functional diversity. All ecosystems contain large numbers of microorganisms and these are frequently transported over large distances. Similar to those reported for higher organisms, microbial communities also have adverse or beneficial effects of pesticide use. Some microorganisms, particularly bacteria use pesticides as a source of nutrients for their growth and survival while sensitive species get impaired by pesticides. For pesticide degradation in the environment microorganisms also plays an important role. Biodegradation of pesticides by microorganisms make the environment clean by decreasing the accumulation of pesticide in the environment. Important process like mineralization, nitrification and phosphorus recycling are dependent much on the balanced equilibrium among the various groups of organisms in the soil. Microorganisms get the exposure of pesticides during the soil application of pesticides, spray drifts from plants to environment, throwing of pesticides on soil and pesticides in water ecosystem. Fungal species in the soil are generally damaged by use of herbicides. for example herbicides like trifluralin and oryzalin are both known to stop the growth of symbiotic mycorrhizal fungi that help in nutrient uptake. The number of fungal spores is reduced by the use of Oxadiazon. Triclopyr is toxic to certain species of mycorrhizal fungi. The growth and activity of nitrogen-fixing bacteria in soil is inhibited by use of non selective herbicide like Glyphosate. Similarly, the use of 2, 4-D stops the conversion of ammonia into nitrates carried out by the soil bacteria. The bacteria dependent processes like nitrification and denitrification in the soil is also disrupted by use of fungicides like Chlorothalonil and dinitrophenyl. Furthermore earthworms are important organisms in the soil to maintain the soil quality also found to be affected by indiscriminate use of pesticides in agricultural practices. Extensive and misuse of pesticides, like carbamate insecticides are very toxic to earthworms and the use of some organophosphates have also been shown to decrease the populations of earthworm. Similarly, a field study conducted in South Africa has also reported that earthworm population was badly affect by their exposures to chlorpyrifos and azinphos methyl. Affect feeding activity and viability of earthworms affected by use of Glyphosates.

V. PESTICIDE EFFECT ON AQUATIC ENVIRONMENT

Aquatic environment includes aquatic plants, micro and macro invertebrates and vertebrates such as fish and amphibians are affected by direct or indirect exposure of the pesticides through overspray, runoff or spray drift. The effect of pesticides on aquatic environment is determined by their water solubility and uptake ability within an organism, for example, Clomazone is principally a water soluble herbicide that increases the possibility of contamination of surface and groundwater .Fish mortality worldwide have been linked with injudicious use of pesticide for agriculture, for example, twenty seven freshwater fish species in Europe and in India were found to be affected by use of pesticides. Behavioral change, depletion in amphibian survival, growth, and development has been linked with pesticides use.

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Toxicity data involving effects of pesticides on aquatic microorganisms are limited. Most studies have done on pesticides breakdown by microbes rather than effects on microorganism populations. Most of the available pesticide data regarding its effect on aquatic microorganisms is for algae. For example it has been found that the growth rate of algae *Calluna vulgaris reduced 15% by* use of 10 mg/litre of Endosulfan and growth of this algae was completely inhibited at 100mg/litre of endosulfan. In another alga,*Anabaena doliolum*, complete inhibition of growth takes place at Endosulfan concentration greater than 3 mg/litre. Studies have shown that 100mg/litre of malathion had little impact on the green alga *Chlorella pyrenoidosa*, and not badly affected by accumulated levels (50 to 72 mg/litre) of parathion. Mani and Konar Examined the toxicity of chlorpyrifos in aquatic environment and noticed that 0.02mg/litre chlorpyrifos remarkably reduced dissolved oxygen and increased free carbon dioxide. Study of comparison of toxicity level of two herbicide triazine compounds on freshwater algae; the triazine gardoprim decreased growth rates of a freshwater algae community at concentration above 0.05 mg/litre, whereas gesapax combi shown no adverse effects at 0.1 mg/litre.

VI. CONCLUSION

These discussions about the pesticide clearly indicates the harmful concerns of indiscriminate use of pesticide, results in various ill effects in the environmental system and human health because many pesticides are not degradable and persists in soil, ground water and in the environment. Some of the ill effects linked with pesticide use have appeared in the form of increase in resistant pest population, decline in beneficial organisms like predators, pollinators and earthworms, change in soil environment and poisoning of aquatic environment. Pesticides depending upon their chemical behavior can enter the organism, accumulates in food chains and consequently cause the adverse effect on human health. Some of severe and persistent poisoning due to pesticide use causing diseases with effects of varying severity on human health has now come out as a result of intake of polluted water, air and food. Therefore, it is the time that requires thinking about how to reduce the use of pesticides to protect our environment and health hazards linked with it. So, promotion of organic farming and use of bio-pesticides is a best way to reduce the indiscriminate use of chemical pesticides in agriculture only to get short term benefits.

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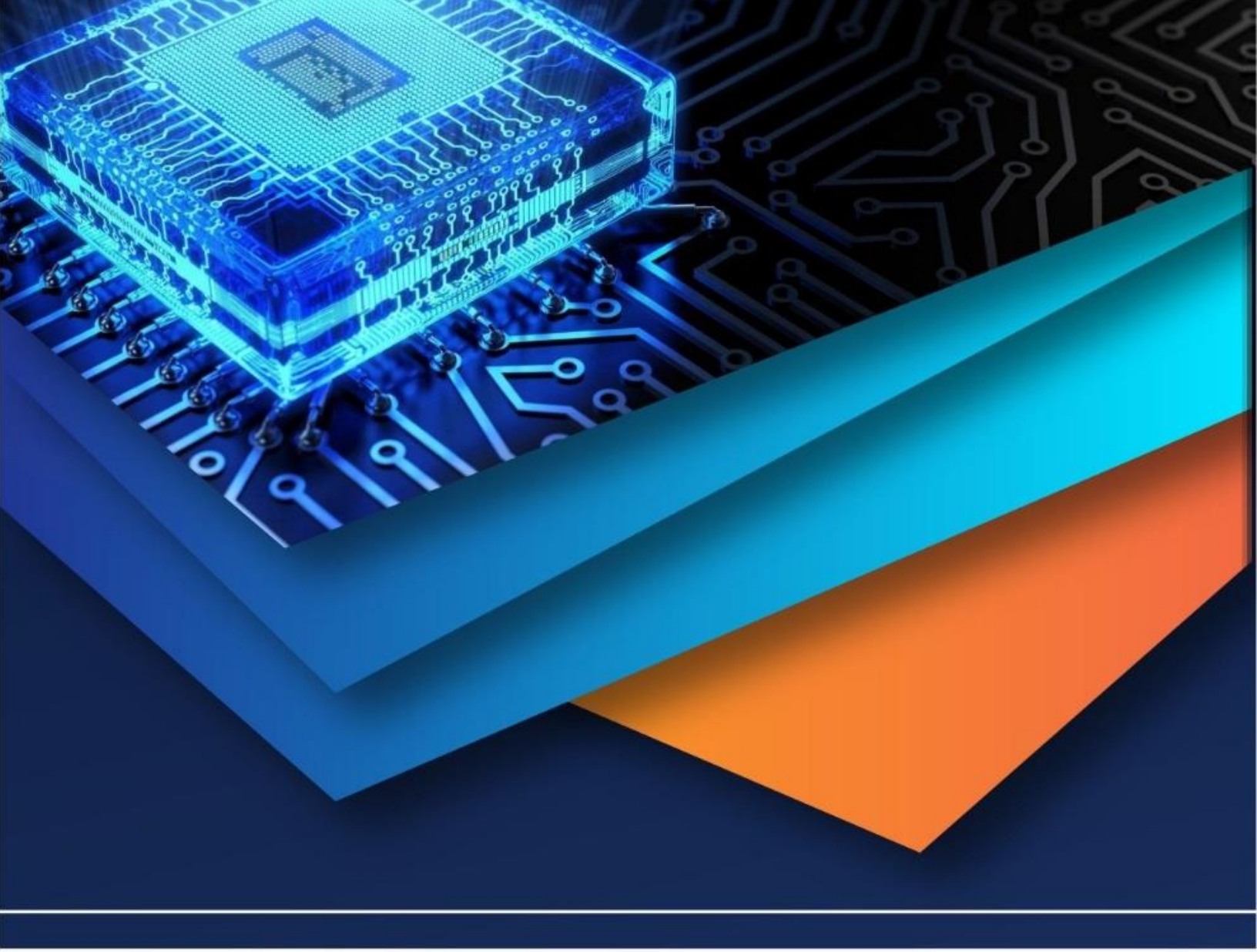

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