Chemical Pesticides and Their Impact on Agriculture and Health-A Review

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Abstract

Populationof of India more than 67 percent lives in rural areas, where the main occupation of the people is agriculture. Agriculture is the backbone of the India's economy as well as the way of life of Indian people. Agriculture safety and food security are the concern to the growing human population all over the world. The immoderate use of pesticides causes negative effects on agriculture and human health. Farmers can be exposed to pesticides in the treatment of crops, pest control and plants. Pesticide includes a range of compounds such as insecticides, fungicides, herbicides, rodenticides, and nematicides, etc. They are not targeting the pest but non target plants animal (natural enemies) such as predators, parasitoids, pollinators, etc. also affected. The harmful effects of chemical pesticides on non-target pests are the major problem in the environment. Along with non-target pests, soil organisms like nematodes, microarthropods, earthworms are also disturbed by the use of pesticides in agriculture. Many scientists have reported the effects of pesticides exposure on the health problems like asthma, cancer, respiratory infection, cardiovascular disease, etc. There are several methods to protect human health and agricultural hazards associated with pesticides including pest control strategies in the IPM (Integrated Pest Management) approach, biocontrol and use of environment-friendly pesticides.

Keywords

Review, Impact, Environment, Non-Target, Pesticides, Predators, Pollinators, Parasitoids, Human Health, Hazardous Effects

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Introduction

Pests are organism that causes damage to plants, humans other creatures. Pesticide is the substance that is used to control undesired insects, weeds, rodents, fungi, bacteria and other organism (Muller, 2018; Karise and Mand 2015). Approximate more than 90 percent of insecticides and herbicides reach other place than their target species because they sprayed entire agricultural fields which are harmful to non-target species. Although chemical pesticides are very costly but regardless of the high costs, the widespread use of chemical pesticides has been preferred because they provide high production in agriculture due to the protecting crops from pest damage. On the other hand, pesticides create serious problems to human health (Kumar et al., 2012; Jeephet et al., 2016; Richardson et al., 2017) and agriculture (Aktar et al., 2009; Magee, 1964). Farmers who handling of pesticides, are at high risk of exposure to pesticides when they apply and work in the field (Soares and De Souza 2009, Damalas and Eleftherohorinos, 2011). In some cases farmers face a critical situation by the use of toxic chemicals that are banned, applying incorrect techniques, improper spraying apparatus, insufficient storage practice, reuse ofpesticide containers, and applying unsafe methods due to lack of knowledge (Jallow et al., 2017). The human health range connected with pesticides is from short-term effects such as headaches, skin irritation dizziness and vomiting to chronic effects such as cancers, respiratory disease, asthma and endocrine disruption (Bourguet and Guillemoud, 2016; Stamati et al., 2016;). Furthermore, immoderate use of different kinds of pesticides may cause the demolition of biodiversity, demolition of non-target species, water, soil and air contamination (Recena et al., 2006; Mitra and Raghu, 1998). The aim of this review is to discuss about the hazardous effect of pesticides on human health and agriculture.

Impact of Pesticide on Insect Natural Enemies

All crops are infected by different pests but some of them are controlled by biologically and chemically. All arthropods including insects and their close relatives serve as food for other organism such as predators, parasitic insects, microorganisms, birds, insect-eating mammals and plants. Insects that use arthropods as a resource are called natural enemies and biological control agents (Karen and Theiling, 1988). Natural enemies are helpful to keep plant-feeding insects from damaging population levels but when pesticides are used to control one pest, cause outbreak of other pest because of the chemical destruction of natural enemies.

Predators

A predator is an organism that kills and eats another organism (Angeliki et al., 2015; Rasmussen et al., 2013). These are usually active because they hunt their

prey and kill them (Theiling and Croft, 1988). Therefore predators are an important part of a natural control program for agriculture (Sasmal et al., 2017; Bueno et al., 2017). Some predators like spiders, predatory mites, ground beetles, ladybird beetles, predatory bugs, robber flies and syrphid fly larvae are found in the agriculture (Johnson et al., 2013). Although, the combination of chemicals and biological controlare helpful for the attainment of an integrated pest management (IPM) program but pesticides destroy the ecological balance and kill natural enemies. The harmful effect of pesticides on predators are in some conditions such as by direct contact of spray droplets, by uptake of residues, feed of contaminated food like host, nectar, honeydew etc. (Hanlon and Relyea, 2013; Ngin et al., 2017).

Table 1 some predators and their preys

Predators	**Prey**
Amoebae	Soilborne fungi, bacteria
Anthocorid bugs	Spider mites, thrips, aphids, pear psylla, various insect eggs
Bigeyed bugs	Lygus bugs, aphids, leafhoppers, spider mites
Collembola	Fungi
Ladybird beetles	Aphids, scale insects, mealybugs, leaf hopper
Lacewings	Aphids, scale, insects, mealybugs, thrips, mites
Mirid bugs	Spider mites, aphids, leafhoppers, scale insects
Mycophagous mites	Fungi,
Nematodes	Soilborne fungi, bacteria
Predatory mites	Red mites spider mites
Spiders	Pear psylla, aphids, leafhopper
Syrphid flies	Aphids, scale insects
Praying mantis	Aphids, mosquitoes, larger bugs

Parasitoids

Parasitoids are similar to parasites. Generally, they are smaller and weaken than their host but really kill their host. Parasitoids are depends on or withininsect host for their foods and then ultimately killing the host. They are used as biological control agents it means similar to chemical pesticides but they attain pest management in an environmentally friendly way (Machtinger et al., 2015; Ballal and Verghese, 2015). Different types of beneficial insect parasitoids are wasps, flies, beetles etc. They may be divided into endo or ectoparasitoids and idio or koinobiont. Endoparasitoids live within their host ectoparasitoids on the host's body. Idiobiont parasitoids prevent further development of the host after initially immobilizing such as egg parasitoids, whereas koinobion parasitoids allow the host to continue its

development like larval- pupal parasitoids. Insecticides are effective against target pests but also harmful to parasitoids (Rosenheim and Hoy, 1988).

Table 2 Name of some parasitoids with their host

Parasitoid	**Host**
Aphelinid wasps	Aphids, mealybugs, whiteflies
Tachinid flies	Caterpillars, beetles, butterflies
Trichogramma wasps	Moth eggs
Bacillus thuringiensis	Butterfly, moth larvae
Pseudomonas fluorescens	Fungi
Polyhedrosis virus	Butterfly, moth larvae
Trichoderma harzianum	Pythium, rhizoctonia
Ampelomyces quisqualis	Powdery mildew
Arthrobytris	Nematodes
Steinernema	Insect larvae
Pasteuria penetrans	Nematodes
Ichneumonid wasps	Caterpillars, beetles, moths
Braconid wasps	Greenfly, caterpillars
Chalcid wasps	Whitefly, cabbage caterpillars

Pollinators and Pesticide

About 80 % of flowering plants need pollinators to survive. Insect are good pollinators of flowering plants, fruit crops such as apples, cherries, pears, plums, peaches, strawberries etc. Different kinds of insects like honey bees, hoverfly, butterfly, beetles, wasps, moth, birds and flies. etc. are good pollinators. Approximately one third part of the pollination is completed by honeybees (Basu and Chakrabarti, 2015). In agriculture, using of pesticides causes loss of insect pollinators and then loss of crops due to shortage of population of pollinators.Pollination is essential for the production of agricultural crops.(Heylen et al.,2010). Many scientists had reported that honeybee population is decrease by use of insecticides such as carbamate, pyrethroid and organophosphorus etc. (Kumar et al., 2018). Pesticide risk is unlimited its toxicity and it becomes fatal to insect. This fatal toxicity is responsible for decrease pollinator individual as well as colonies. (Desneux et al., 2007). It has been reported that bumblebee colonies exposed to imidacloprid and have harmful impacts on fertility(Gill et al., 2012).Many scientists have demonstrated thiamethoxam as a major factor to cause increase mortality (Henry et al., 2012). Other pollinators get exposed to insecticides by residues in pollen and nectar, dew droplets on contaminated plants, soil and water.

Pesticide on Soil Microbes

Soil microorganism plays an important role in plants to provide water, nutrient and break down compounds. Soil microbes have the capacity of biochemical transformation of some elements such as nitrogen, phosphorus, sulphur etc. Plants depend on microbes in the soil to obtain water, soluble nutrients, and break down compounds that enhance plant growth. When pesticides are used on plants, they leaches in to the soil and then they can kill the microorganism living in the soil which are responsible for break down organic material and beneficial in plant growth (Pal et al., 2006; Usman, 2018; Kalia and Gosal, 2011). Use of pesticides and their degraded products may accumulate in the soil ecosystem causes a serious problem to human being and environment (Yousaf et al., 2013; Digrak and Ozcelik, 1998; Prashar and Shah, 2016).

Human Health and Pesticides

Approximate more than five pounds of chemical pesticides are used per year. Pesticides are used in agriculture as well as in homes in form of sprays, powders, poisons to kill cockroaches, mosquitoes, fleas, rats etc. On the bases of their action pesticides can be classified as fungicides, insecticides, herbicides etc. Pesticides are used for the improving the standard of human health by controlling different disease but their long term use has resulted in serious health effects. According to world health organization every year approximate three billion cause of pesticide poisoning and about two lakhs deaths are reported.Pesticides enter the human body by ingestion, inhalation or penetration through skin. But most of the people get harmful effect by pesticide contaminated food (Stachniuk et al., 2017; Popp et al., 2013; Reeves et al., 2019). After the entering in the human body they reach human tissues. Human body have capacity for the excretion of toxins, but in some cases, it retains them by absorption in the circulatory system. If the concentration of pesticides in the body is increased the toxic effect are produced. The effect of pesticides on human health may appear in short time or they may take months or years to manifest and hence are called chronic or long term effects (Mostafalou and Abdollahi, 2013; Ye et al., 2017). Many scientists have reported that human brain is not fully developed until the age of twelve. Therefore they absorb greater amounts of chemicals via their lungs and take in more air, food and water comparison to adults. Children have less capability of fighting with toxic substances.

Table 3 Name of some chemicals, types, harmful effects and used in agriculture

Chemical Name	Type	Health Effect	Used in Aagriculture
Azoxystrobin	Fungicide	Skin redness, eye pain, headache, dizziness, chey6st pain	Grapes, cereals, potatoes, bananas, apples, rice
Boscalid	Fungicide	Headache, dizziness, nausea, vomiting, sore throat, coughing	Crop such as strawberries, beans, stone fruit, root vegetables, carrots, sunflowers
Cyprodinil	Fungicide	Skin and eye irritation,	On cereals, grapes, pome fruit, stone fruit, vegetable, ornamentals
Carbendazim	Fungicide	Poisonous by ingestion and mildly toxic by inhalation	Green beans, strawberries, apple, sweet bell peppers, bananas, green onions
Chlorothalonil	Fungicide	Eye and skin irritation, coughing, cancer	Trees, small fruits, vegetable, ornamentals
Dicloran	Fungicide	Abdominal pain, constipation, diarrhea, nausea, vomiting	On ornamentals, fruit, and vegetable crops such as cucumber, carrots, snap beans, cherries, garlic, onions, potatoes
Fludioxonil	Fungicide	Liver necrosis, increased serum cholesterol, inflammation, cysts in kidney	Fruit such as apples, blackberries, bilberries, dwarf French beans, broad beans, strawberries, pears
Myclobutanil	Fungicide	Nausea, vomiting, coughing, eye and skin irritation	On grapes vegetative crops
Metalaxyl	Fungicide	Eye and skin irritation	Tropical and subtropical crops, soil borne pathogens, downy mildews
Pyraclostrobin	Fungicide	Skin redness, eye pain, weakness, headache, dizziness, chest pain	Variety of fruits such as melons, apples, sunflowers, beans, peppers, cucumbers
Trifloxystrobin	Fungicide	Skin and eye irritation	Control to brown patch, red thread, rust, anthracnose, dollar spot
Thiabendazole	Fungicide	Dizziness, anorexia, nausea, vomiting	Control mold, rot, blight and stain on fruits and vegetables

Atrazine	Herbicide	Abdominal pain, diarrhea, vomiting, respiratory, digestive, nervous system	Eliminate noxious weeds in major crops
Fluridone	Herbicide	Eye and skin irritation	Control aquatic weeds in freshwater ponds
Metolachlor	Herbicide	Skin irritation, acute lung injury, anemia, abdominal cramps	Control weeds in corn, soybeans, peanuts, potatoes, cotton, grain sorghum
Oxyfluorfen	Herbicide	Eye, skin, respiratory infection, nausea, dizziness, headache, vomiting	Control broadleaf and grass weeds in fruit, vegetable and ornamentals
Propazine	Herbicide	Muscular weakness, diarehea, labored breathing emaciation	Control broadleaf and annual grasses weeds in sweet sorghum
Pendimethalin	Herbicide	Skin and eye irritant, inhalation of dusts or fumes may be moderately irritating to the linings of the mouth, nose, throat and lungs	Protect crops such as wheat, corn, soybeans potatoes, cabbage, peas, carrots and asparagus
Trifluralin	Herbicide	Allergic skin reaction, redness, irritation of the lining of the mouth, nose, throat, may damage liver, kidney	Control broadleaf weeds on vegetable crops, flowers, cotton, alfalfa, sunflowers, soybeans
Tebuthiuron	Herbicide	Diarrhea, anorexia, increased liver, kidney, thyroid weights	Control weeds in alfalfa, bluegrasses, dock, goldenrod
Acephate	Insecticide	Muscle twitching, weakness, tremor, headache, dizziness, nausea, diarrhea, vomiting	Treat species in fruit, vegetable, vine, protect from biting and sucking insects
Aldicarb sulfone	Insecticide	Nausea, trearing, sweating, headache, weakness, blurred vision	Control spider mites, aphids, fleahopers, lygus, leafminers
Acetamiprid	Insecticide	Diarrhea, vomiting, abdominal pain, eye irritation	Control sucking type insects and spray on cherries, apple, pears, tomatoes
Bifenthrin	Insecticide	Headache, nausea, vomiting, fatigue, diarrhea	Control red fire ants, moths, grasshoppers, mites, spiders, caterpillars, flies

Coumaphos	Insecticide	Eye irritation, damage body organs	Control livestock insects such as cattle grubs, screw worms, lice, scabies, flies and ticks
Chloropyrifos	Insecticide	Runny nose, tears, increased saliva or drooling	Control cutworm, corn rootworm, cockroaches, grubs, flea beetles, flies, termites, fire ants, lice
Cypermethrin	Insecticide	Headache, muscle, weakness, salivation, shortness of breath	Toxic to bees, fish and aquatic insects, cockroaches, ant
Cyfluthrin	Insecticide	Sweating, rhino rhea, tearing, excessive	Control cutworm, ants, silverfish, termites, green beetles, mosquitoes, fleas, flies, corn earworms
Diazinon	Insecticide	Salivation, sweating, headache, diarrhea, lacrimation, muscle twitching	On rice, sugarcane, corn tobacco, potatoes, fruit tree
Diflubenzuron	Insecticide	Coughing, suffocation, shortness of breath, emphysema, dizziness	Control leaf eating larvae of insects such as gypsy moths, mosquito, rust mites
Dieldrin	Insecticide	Vomiting, irritation, headache, uncontrolled muscle movements	Control insect on cotton, corn, citrus crops and kill to mosquitoes, locusts
Dichlorvos	Insecticide	Vomiting, diarrhea, fatigue, coma, drowsiness, headache	On spider mites, caterpillars, white flies, thrips, mushroom flies
Dicofol	Insecticide	Weakness, eye and skin irritation, affect on kidney, liver and central nervous system	On fruit, vegetable, ornamental and field crops
Esfenvalerate	Insecticide	Dizziness, burning, itching, weakness, temporary nervous system	On moths, flies, beetles, bees
Fenpropathrin	Insecticide	Eye and skin irritation, creeping on skin, sensation of prickling	Control mites in fruit and vegetation
Fluvalinate	Insecticide	Sneezing, throat irritation, coughing, itching or burning sensations nausea, headache	On honey bees for varroa mites
Flonicamid	Insecticide	Consciousness disturbance, shock, respiratory failure, pneumonia	Control hemipterous, sucking insects such as aphids and whiteflies
Imidacloprid	Insecticide	Drooling, vomiting, breathelessness, skin and eye irritation	Control beetles, fleas aphids, stink bugs, termites, locusts, carpenter ants, thrip, cockroaches
Methoxyfenozide	Insecticide	Respiratory distress syndrome, acute lung injury, bronchitis, pneumonitis	Target on lepidopterous insects
Methamidaphos	Insecticide	Abdominal cramps, tearing, runny nose, headache, tightness of the chest	On aphids, flea beetles, worm, whiteflies, thrips, cabbage looper, potato tubeworm
Methomyl	Insecticide	Respiratory tract, digestive tract, trigger, chest pain	On spiders and ticks
Paradichlorobenzene	Insecticide	Skin and eye irritation, headache, vomiting, dizziness	Moths moth larvae

Conclusion

Pesticides are important part for agricultural production but continuously use of pesticides, results in some negative effects in the agricultural components and human health. The above discussion clearly highlights the adverse effects of pesticides have emerged in the form of decline on helpful organisms such as parasitoids, predators, pollinators and soil microorganism. According to their chemical nature, pesticides enter the organism, reaches in the food and hence influences human health. Therefore, it is needs to proper use of pesticides to protect our agriculture and health hazards. To reduce the use of chemicals, it is requires immediate action to promote the organic farming practices and try to find bio pesticidesor natural enemies to control agricultural pests.

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