Journal of Advances in Science and Technology

Vol. IV, No. VIII, February-2013, ISSN 2230-9659

AN OVERVIEW OF SOIL POLLUTION CONTROL BY USING BACTERIAE

www.ignited.in

Journal of Advances in Science and Technology
Vol. IV, No. VIII, February-2013, ISSN 2230-9659

An Overview of Soil Pollution Control by Using Bacteriae

Dharmendra Singh

Research Scholar, CMJ University, Shillong, Meghalaya, India

Abstract: Agriculture is the back bone of world economy and in India about60% of the population depends on agriculture as their only occupation. In India to maintain self reliance, the food production should be increased to about 300 million tones. Important factors that affect attaining and maintaining the food production are population, land availability, and the devastation of agricultural products by the pests, insects and fungus. It is estimated that 35% of the potential production is lost due to pests, insects and fungus (Cramer, 1967). To achieve increased food production from limited land resources, attention on pest control is very important. Chemical control of pests, insects, and fungus to prevent losses in agriculture commenced in India around the year 1948-49. Originally some pesticides, insecticides and fungicides like DDT and other compounds were imported in the formulated form into the country for mosquito control. Slowly, the country started using these pesticides, insecticides and fungicides for agricultural practices. The first plant for the manufacture of technical BHC and its formulation was put up in the country in 1952, followed by a plant for the manufacture of DDT in 1955.

----------♦----------

OVERVIEW

One of the consequences of technological progress in agricultural revolution has been the release of large number of chemicals into the environment. Although a variety of alternative pest control methods are available in recent years, use of chemical pesticides, insecticides and fungicides is still the mainstay in modern agricultural practice.

PESTICIDES

A pesticide is a substance or mixture of substances used to kill a pest. A pesticide is any substance or mixture of substance intended for: - preventing, destroying, repelling or mitigating any pest. A pesticide may be a chemical substance, biological agent (such as a virus or bacteria), antimicrobial, disinfectant or device used against any pest. Pests include insects, plant pathogens, weeds, molluscus, birds, mammals, fish, nematodes (roundworms) and microbes that compete with humans for food, destroy property, spread or are a vector for disease or cause a nuisance. Although there are benefits to the use of pesticides, there are also drawbacks, such as potential toxicity to humans and other animals. FAO has defined the term of pesticide as:

any substance or mixture of substances intended for preventing, destroying or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals causing harm during or otherwise interfering with the production, processing, storage, transport or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs, or substances which may be administered to animals for the control of insects, arachnids or other pests in or on their bodies. The term includes substances intended for use as a plant growth regulator, defoliant, desiccant or agent for thinning fruit or preventing the premature fall of fruit, and substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport.

TYPES OF PESTICIDES

Pesticides are used to control organisms which are considered harmful. Broad-spectrum pesticides are those that kill an array of species, while narrow-spectrum, or selective pesticides only kill a small group of species. The different types of pesticides are:

- Algicides or algaecides for the control of algae
- Avicides for the control of birds
- Bactericides for the control of bacteria
- Fungicides for the control of fungi and oomycetes
- Herbicides (e.g. glyphosate) for the control of weeds

Insecticides(e.g.organochlorines,organophosphates, carbamates, and pyrethroids) for the control of insects - these can beovicides (substances that kill eggs), larvicides (substances that kill larvae) or adulticides (substances that kill adults)

- Miticides or acaricides for the control of mites
- Molluscicides for the control of slugs and snails
- Nematicides for the control of nematodes
- Rodenticides for the control of rodents
- Virucides for the control of viruses (e.g. H5N1)

Pesticides can also be classed as synthetic pesticides or biological pesticides (biopesticides), although the distinction can sometimes blur. A systemic pesticide moves inside a plant following absorption by the plant. With insecticides and most fungicides, this movement is usually upward (through the xylem) and outward. Increased efficiency may be a result. Systemic insecticides which poison pollen and nectar in the flowers may kill needed pollinators such as bees. Most pesticides work by poisoning pests.

In 2009, the development of a new class of fungicides called paldoxins has been announced. These work by taking advantage of natural defense chemicals released by plants called phytoalexins, which fungi then detoxify using enzymes. The paldoxins inhibit the fungi's detoxification enzymes. They are believed to be safer and greener.

PESTICIDE AND ITS APPLICATIONS

Pesticides are used to kill mosquitoes that can transmit potentially deadly diseases like West Nile, yellow fever, and malaria. They can also kill bees, wasps or ants that can cause allergic reactions. Insecticides can protect animals from illnesses that can be causedby parasites such as fleas. Pesticides can prevent sickness in humans that could be caused by moldy food or diseased produce. Herbicides can be used to clear roadside weeds, trees and brush. They can also kill invasive weeds in parks and wilderness areas which may cause environmental damage. Herbicides are commonly applied in ponds and lakes to control algae and plants such as water grasses that can interfere with activities like swimming and fishing and cause the water to look or smell unpleasant. Uncontrolled pests such as termites and mould can damage structures such as houses. Pesticides are used in grocery stores and food storage facilities to manage rodents and insects that infest food such as grain. Each use of a pesticide carries some associated risk. Proper pesticide use decreases these associated risks to a level deemed acceptable by pesticide regulatory agencies such as the United States Environmental Protection Agency (EPA) and the Pest Management Regulatory Agency (PMRA) of Canada.

Pesticides can save farmers' money by preventing crop losses to insects and other pests; in the US, farmers get an estimated fourfold return on money they spend on pesticides. One study found that not using pesticides reduced crop yields by about 10%. Another study, conducted in 1999, found that a ban on pesticides in the United States may result in a rise of food prices, loss of jobs, and an increase in world hunger DDT, sprayed on the walls of houses, is an organochloride that has been used to fight malaria since the 1950s. Recent policy statements by the World Health Organization have given stronger support to this approach. Dr. Arata Kochi, WHO's malaria chief, said, "One of the best tools we have against malaria is indoor residual house spraying. Of the dozen insecticides WHO has approved as safe for house spraying, the most effective is DDT. However, since then, an October 2007 study has linked breast cancer from exposure to DDT prior to puberty. Poisoning may also occur due to use of DDT and other chlorinated hydrocarbons by entering the human food chain when animal tissues are affected. Symptoms include nervous excitement, tremors, convulsions or death. Scientists estimate that DDT and other chemicals in the organophosphate class of pesticides have saved 7 million human lives since 1945 by preventing the transmission of diseases such as malaria, bubonic plague, sleeping sickness, and typhus. However, DDT use is not always effective, as resistance to DDT was identified in Africa as early as 1955, and by 1972 nineteen species of mosquito worldwide were resistant to DDT. A study for the World Health Organization in 2000 from Vietnam established that non-DDT malaria controls were significantly more effective than DDT use. The ecological effect of DDT on organisms is an example of bioaccumulation.

ORIGIN OF PESTICIDES

Since before 2500 BCE, humans have utilized pesticides to protect their crops. The first known pesticide was elemental sulfur dusting was used about 4,500 years ago. By the 15th century, toxic chemicals such as arsenic, mercury and lead were being applied to crops to kill pests. In the 17th century, nicotine sulfate was extracted from tobacco leaves for use as an insecticide. The 19th century saw the introduction of two more natural pesticides, pyrethrum which is derived from chrysanthemums, and rotenone which is derived from the roots of tropical vegetables.

In 1939, Paul Müller discovered that DDT was a very effective insecticide. It quickly became the most widely used pesticide in the world. In the 1940s manufacturers began to produce large amounts of synthetic pesticides and their use became widespread. Some sources consider the 1940s and

1950s to have been the start of the "pesticide era." Pesticide use has increased 50-fold since 1950 and 2.3 million tonnes (2.5 million short tons) of industrial pesticides are now used each year. Seventy-five percent of all pesticides in the world are used in developed countries, but use in developing countries is increasing.

In the 1960s, it was discovered that DDT was preventing many fish-eating birds from reproducing, which was a serious threat to biodiversity. Rachel Carson wrote the best-selling book Silent Spring about biological magnification. The agricultural use of DDT is now banned under the Stockholm Convention on Persistent Organic Pollutants, but it is still used in some developing nations to prevent malaria and other tropical diseases by spraying on interior walls to kill or repel mosquitoes.

UNIVERSAL REGULATION AND CONTROL

In most countries, in order to sell or use a pesticide, it must be approved by a government agency. For example, in the United States, the Environmental Protection Agency (EPA) does so. Complex and costly studies must be conducted to indicate whether the material is safe to use and effective against the intended pest. During the registration process, a label is created which contains directions for the proper use of the material. Based on acute toxicity, pesticides are assigned to a Toxicity Class.

Some pesticides are considered too hazardous for sale to the general public and are designated restricted use pesticides. Only certified applicators, who have passed an exam, may purchase or supervise the application of restricted use pesticides. Records of sales and use are required to be maintained and may be audited by government agencies charged with the enforcement of pesticide regulations.

In Europe, recent EU legislation has been approved banning the use of highly toxic pesticides including those which are carcinogenic, mutagenic or toxic to reproduction, those which are endocrine-disrupting, and those which are persistent, bioaccumulative and toxic (PBT) or very persistent and very bioaccumulative (vPvB). Measures were approved to improve the general safety of pesticides across all EU member states.

In Canada, 154 municipalities and the entire provinces of Quebec and Ontario have now placed restrictions on the cosmetic use of synthetic lawn pesticides as a result of health and environmental concerns. The Ontario provincial government promised on September 24, 2007 to also implement a province-wide ban on the cosmetic use of lawn pesticides, for protecting the public. Medical and environmental groups support such a ban. On April 22, 2008, the Provincial Government of Ontario announced that it will pass legislation that will prohibit, province-wide, the cosmetic use and sale of lawn and garden pesticides. The Ontario province-wide pesticide ban on lawn pesticides will come into force on Earth Day, April 22, 2009.

Over 250 products will be banned for sale and more than 95 pesticide ingredients will be banned for cosmetic uses. The Ontario legislation would also echo Massachusetts law requiring pesticide manufacturers to reduce the toxins they use in production. The Province of Prince Edward Island has also announced that it will pass legislation that bans cosmetic pesticides, starting 2010. On April 3, 2008, the Canadian Cancer Society released opinion poll results conducted by Ipsos Reid, which established that a clear majority of residents in the provinces of British Columbia and Saskatchewan want province-wide cosmetic lawn pesticide bans, and that the majority of respondents believe that cosmetic pesticides are a threat to their health.

Though pesticide regulations differ from country to country, pesticides and products on which they were used are traded across international borders. To deal with inconsistencies in regulations among countries, delegates to a conference of the United Nations Food and Agriculture Organization adopted an International Code of Conduct on the Distribution and Use of Pesticides in 1985 to create voluntary standards of pesticide regulation for different countries. The Code was updated in 1998 and 2002. The FAO claims that the code has raised awareness about pesticide hazards and decreased the number of countries without restrictions on pesticide use.

Two other efforts to improve regulation of international pesticide trade are the United Nations London Guidelines for the Exchange of Information on Chemicals in International Trade and the United Nations Codex Alimentarius Commission. The former seeks to implement procedures for ensuring that prior informed consent exists between countries buying and selling pesticides, while the latter seeks to create uniform standards for maximum levels of pesticide residues among participating countries. Both initiatives operate on a voluntary basis (Annual Report WHO, 2004).

Reading and following label directions is required by law in countries such as the US and in limited parts of the rest of the world. One study found pesticide self-poisoning the method of choice in one third of suicides worldwide,and recommended,aong other things, more restrictions on the types of pesticides that are most harmful to humans.

ENVIRONMENTAL EFFECTS

Pesticide use raises a number of environmental concerns. Over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species, including non-target species, air, water, bottom sediments and food. Pesticide drift occurs when pesticides suspended in the air as particles are carried by wind to other areas, potentially contaminating them. Pesticides are one of the causes of water pollution, and some pesticides are persistent organic pollutants and contribute to soil contamination.

HEALTH EFFECTS

Pesticides can present danger to consumers, bystanders, or workers during manufacture, transport, or during and after use. The American Medical Association recommends limiting exposure to pesticides and using safer alternatives.

Particular uncertainty exists regarding the long-term effects of low- dose pesticide exposures. Current surveillance systems are inadequate to characterize potential exposure problems related either to pesticide usage or pesticide-related illnesses. Considering these data gaps, it is prudent to limit pesticide exposures and to use the least toxic chemical pesticide or non- chemical alternative.

FARMERS AND WORKERS

There have been many studies of farmers with the goal of determining the health effects of pesticide exposure. The World Health Organization and the UN Environment Programme estimate that each year, 3 million workers in agriculture in the developing world experience severe poisoning from pesticides, about 18,000 of whom die. According to one study, as many as 25 million workers in developing countries may suffer mild pesticide poisoning yearly.

Organophosphate pesticides have increased in use, because they are less damaging to the environment and they are less persistent than organochlorine pesticides. These are associated with acute health problems for workers that handle the chemicals, such as abdominal pain, dizziness, headaches, nausea, vomiting, as well as skin and eye problems. Additionally, many studies have indicated that pesticide exposure is associated with long- term health problems such as respiratory problems, memory disorders, dermatologic conditions, cancer, depression, neurological deficits, miscarriages, and birth defects. Summaries of peer-reviewed research have examined the link between pesticide exposure and neurologic outcomes and cancer, perhaps the two most significant things resulting in organophosphate-exposed workers.

According to researchers from the National Institute of Health (NIH), licensed pesticide applicators who used chlorinated pesticides on more than 100 days in their lifetime were at greater risk of diabetes. In a paper appearing in the May, 2008, issue of the American Journal of Epidemiology, researchers said the associations between specific pesticides and incident diabetes ranged from a 20 percent to a 200 percent increase in risk. New cases of diabetes were reported by 3.4 percent of those in the lowest pesticide use category compared with 4.6 percent of those in the highest category. Risks were greater when users of specific pesticides were compared with applicators who never applied that chemical.

EFFECT OF PESTICIDES ON CONSUMERS

There are concerns that pesticides used to control pests on food crops are dangerous to people who consume those foods. These concerns are one reason for the organic food movement. Many food crops, including fruits and vegetables, contain pesticide residues after being washed or peeled. Chemicals that are no longer used but which are resistant to breakdown for long periods may remain in soil and water and thus in food.

The United Nations Codex Alimentarius Commission has recommended international standards for Maximum Residue Limits (MRLs), for individual pesticides in food.

In the EU, MRLs are set by DG-SANCO. In the US, levels of residues that remain on foods are limited to tolerance levels that are established by the U.S. Environmental Protection Agency and are considered safe. The EPA sets the tolerances based on the toxicity of the pesticide and its breakdown products, the amount and frequency of pesticide application, and how much of the pesticide (i.e., the residue) remains in or on food by the time it is marketed and prepared. Tolerance levels are obtained using scientific risk assessments that pesticide manufacturers are required to produce by conducting toxicological studies, exposure modeling and residue studies before a particular pesticide can be registered, however, the effects are tested for single pesticides, and there is little information on possible synergistic effects of exposure to multiple pesticide traces in the air, food and water.

A study published by the United States National Research Council in 1993 determined that for infants and children, the major source of exposure to pesticides is through diet. A study in 2006 measured the levels of organophosphorus pesticide exposure in 23 school children before and after replacing their diet with organic food (food grown without synthetic pesticides). In this study it was found that levels of organophosphorus pesticide exposure dropped dramatically and

immediately when the children switched to an organic diet.

EFFECT OF PESTICIDES ON PUBLIC

Exposure routes other than consuming food that contains residues, in particular pesticide drift are potentially significant to the general public. The Bhopal disaster occurred when a pesticide plant released 40 tons of methyl isocyanate (MIC) gas, a chemical intermediate in the synthesis of some carbamate pesticides. The disaster immediately killed nearly 3,000 people and ultimately caused at least 15,000 deaths. In China, an estimated half million people are poisoned by pesticides each year, 500 of whom die. Children have been found to be especially susceptible to the harmful effects of pesticides. A number of research studies have found higher instances of brain cancer, leukemia and birth defects in children with early exposure to pesticides, according to the Natural Resources Defense Council. Often used for ridding school buildings of rodents, insects, pests, etc., pesticides only work temporarily and must be re-applied. The poisons found in pesticides are not selectively harmful to just pests and in everyday school environments children (and faculty) are exposed to high levels of pesticides and cleaning materials. "No testing has ever been done specifically pertaining to threats among children".Peer-reviewed studies now suggest neurotoxic effects on developing animals from organophosphate pesticides at legally tolerable levels, including fewer nerve cells, lower birth weights, and lower cognitive scores. The United States Environmental Protection Agency finished a 10 year review of the organophosphate pesticides following the 1996 Food Quality Protection Act, but did little to account for developmental neurotoxic effects, drawing strong criticism from within the agency and from outside researchers.

REFERENCES

1. Alexander M, 1965, Biodegradation: Problems of Molecular recalcitrane and microbial falsibility. Adv. Appl. Microbiol. 7:35-80.

2. Alexander M, 1972. Microbial influence on pesticide degradation. In environmental Toxicology of Pesticides, ed. G. Mallory Boush, Fumio Matsumura, Tomamasa Misato, P. 365-382, New York and London: Academic Press.

3. Alexander M, 1985. Biodegradation of organic chemicals. Environ. Sci. technol. 18: 106-111.

4. Aneja K.R. 1993. Experiments in Microbiology, Plant Pathology and Tissue culture. ed. Wishwa Prakasan, New Delhi, 234-235.

5. Appl Environ Microbiol. 2001 October; 67(10):4922–4925.doi:0.1128/AEM.67.10 4922 - 4925.2001.

6. Association of Official Analytical Chemists. 1995 th Bacteriological analytical manual, 8 Gaithersburg, MD.

7. Audus O.J. 1949. Plant solil 2:31 ed. AOAC International,

8. Ausubel F M, Kinston R E, Brent R, et al. Short protocols in molecular biology. New York, N.Y: John Wiley & Sons, Inc.;1995.

9. Baushman GL, 1980. Quantitative expression of biotransformation rate. applied microbial. Biotechnol 38: 273- 275.

10. Bavi HO, 1986. Pesticides. Their Industrial and health hazards and environmental pollution in India. Pesticide information. 13: 16-21.

11. Berry DF, Francis, A.J., Bollag, JM, 1987. Microbial metabolism of homocyclic and heterocyclic aromatic compounds under anaerobic conditions. Microbial. Rev. 51: 43-59.

12. Bloomfield BJ, Alexander M, 1967. J. Bacteriol. 93: 1276.

13. Bollag JM, 1974. Microbial transformation of Pesticides. Adv. Appl. Microbial. 18: 75-30.

14. Borle MN, Desymukh SD, 1995. Environmental Pollution in Relation to use of Pesticides. In Toxicity and monitoring of Xenobiotics, ed. Rani Prakash, Prene P Sooh; P. 43-52. Venus Publishing House.

15. Chakrabarty AM, 1982. Toxicity of pesticides. In biodegradation and detoxification of environmental pollutants, P. 1-9. CRC Press inc.