Plant Environment Development 3(2):31-35, 2014 (July)
©Department of Botany, University of Rajshahi
e-mail: plant.environ.dev@ru.ac.bd

Print ISSN 1994-1501
Online ISSN 2311-3529

A Review on Impact of Agrochemicals on Human Health and Environment: Bangladesh Perspective

S.K. Biswas*,S. Rahman, S.M.A. Kobir, T. Ferdous and N.A. Banu

Dept. of Biotechnology and Genetic Engineering, Islamic University, Kushtia, Bangladesh

*Corresponding author's e-mail: shu_genetics@yahoo.com

Abstract

Continuous use of agrochemicals against agricultural pest and disease vectors poses serious threats upon both human health and environment. In developing country like Bangladesh it is very difficult to find out the impact on human health or on the environment due to lack of awareness, training and adequate knowledge for using agrochemicals. Agrochemicals exposure periods and levels, types of agrochemicals used (regarding toxicity and persistence), and various environmental condition of the areas are also factors for acute and chronic poisoning on human health and environment. Agrochemicals users and consumers in Bangladesh are vulnerable to agrochemical related health problems due to inadequate regulatory and preventive mechanisms. This review has revealed the hazardous effect like cancer, neural disorders, birth defects, reproductive and developmental anomalies, mutagenicity and other health related problems and environmental risks associated with agrochemicals exposure.

Keywords: Agrochemicals, Human Health, Environmental impact

INTRODUCTION

Agrochemical (or agrichemical) is a generic term for the various chemical products, such as fertilizer, hormone, fungicide, insecticide, or soil treatment that improves the production of crops. Pesticide as agricultural input was introduced in Bangladesh in 1957 and mainly DDT and BHC (Islam, 2000). Though the use of pesticides in Bangladesh is less in comparison to other developing countries which is 0.03 kg/ha compared to 0.3 kg/ha in India, 0.4 kg/ha in Sri Lanka and 0.8 kg/ha in Indonesia (Sultana and Nobukazu, 2001). However, presently the use of pesticide is gradually increasing. This review was carried out to knowthe adverse effect of agrochemicals, especially pesticide and herbicide and agrochemical use practices. This review also evaluated the farmer's knowledge, attitude and perceptions regarding the impact of pesticides on human health and environment in Bangladesh.

AGROCHEMICAL EXPOSE AND POISONING

No segment of the population of the developing countries like Bangladeshis completely protected against exposure to agrochemicals (pesticides) and the potentially serious health effects. Despite their popularity and extensive use, there is serious concern about health risks arising from the exposure of farmers when mixing and applying pesticides or working in treated fields. From residues of pesticides on food and in drinking water the health risk for the general population have been raised (Pimentel, 2005; Maroni *et.al.* 2006; Soares and Porto, 2009). In Bangladesh like other developing countries, farmers face great risks of exposure due to the use of toxic chemicals that are banned or restricted in other countries, incorrect application techniques, poorly maintained or totally

inappropriate spraying equipment, inadequate storage practices(Asogwa and Dongo, 2009). In addition, several studies have shown that inadequate product labeling and users' lack of information have led to the widespread overuse and misuse of dangerous pesticides. Although monitored health data on the effects of pesticides is not available in Bangladesh, projections suggest an annual incidence of organophosphate (OP) poisoning alone is as high as 900/100,000 population (Dasgupta and Meisner, 2005). In Bangladesh, farmers still apply highly toxic pesticides with leaking equipment, often against wind drift, wearing cotton shirts and waistcloths ('lungi'). Educated farmers alone did not succeed in adoption of safety measures by them. A survey of 110 Bangladeshi pesticide traders (shops) show that**,** 90% of the traders indicated the need for further instructions on pesticide use and handling and over 92% indicated no protection measures were taken during the handling of pesticides (Dasgupta and Meisner, 2005). Also, accidental poisoning with agrochemicals in home is a possibility from the use of chemicals around the house or garden. Vegetables growers used pesticides that may be highly hazardous and which were not registered in most cases. These situations could have unexpected consequences including the exposure of consumers to health hazards (Claude *et.al.,* 2012). In Bangladesh**,** vector control has consequently been intensified in all overthe country with Indoor Residual Spray as a method of choice. The adverse health effects of such indoor insecticide sprays that still include DDT. Television advertisements of ant, mosquito and cockroach control products have become more available and colorful, probably reflecting their rising demand in the market.

HUMAN HEALTH HAZARD

The links between pesticides and human health were suspected as early as the 1960s and 1970s., US epidemiologists observed an unusual rise in Non-Hodgkin's Lymphoma in areas of high pesticide use (Gupta, 2012). A number of more recent studies and reviews bring to light some critical health implications of pesticide exposure.

Acute illnesses

The typical symptoms of acute pesticide poisoning in humans are fatigue, headaches and body aches, skin discomfort, skin rashes, poor concentration, feelings of weakness, circulatory problems, dizziness, nausea, vomiting, excessive sweating, impaired vision, tremors, panic attacks, cramps, etc., and in severe cases coma and death (Bödeker and Dümmler, 1993). Diagnosis of acute pesticide poisoning generally occurs when one or more of these symptoms, which appearin a short time after contact with pesticides, are detected.Among the most perceptible health problems encountered in a survey, 16% of the respondents reported irritation in the eyes, 21% headaches, 6% dizziness, 5% skin irritation and 7% vomiting after handling pesticides (Dasgupta and Meisner, 2005). The interviews further revealed that 30% of the respondents experienced multiple health effects, with the duration of ailment also being quite significant. Traders indicated an average duration of7 hours in terms ofeye irritation, 13 hours for headaches and 21 hours for dizziness (Dasgupta and Meisner, 2005). Another survey report on pesticide poisoning in Dhaka Medical College Hospital from October 2005 to June 2006 showed that total pesticide poisoning cases were10.33% and 16.7% of them died (Shadequl-Islam *et.al.,* 2012). Acute poisoning in the Medicine ward of Khulna Medical College Hospital showed that most commonly found toxic agent was organo-phosphate 27.64% second leading cause 16.03% (Poisoning with unrecognized substance) followed by copper-sulphate 14.03%, sedative 13.35%, snakebite 12.93% etc (Chowdhury *et.al.,* 2011).

Chronic illness

Besides causing acute poisoning, pesticides can also cause chronic illnesses if they are incorporated over a longer period, even the amounts taken up are relatively small. Many agrochemicals especially pesticides that are commonly used today have been classified on the basis of animal testing as possibly or probably carcinogenic for humans (Alavanja *et.al.,* 2004). Although the results of various epidemiological studies are inconsistent, these findings leave no doubt that agricultural workers exposed to pesticides have a significant risk of contracting non-Hodgkin lymphomas and leukemia (Alavanja *et.al.,* 2004). Other studies have revealed a correlation between pesticide use and sarcomas, multiple myelomas, cancer of the prostate, pancreas, lungs, ovaries, the breasts, testicles, liver, kidneys, and intestines as well as brain tumors (Bödeker and Dümmler, 1993). Many widely used pesticides, such as organophosphates, carbamates, pyrethroids, ethylene-bisdithiocarbamates, and chlorophenoxy herbicides should be considered neuro-developmental toxicants. Experimental, clinical, and epidemiologic evidences suggests that neurotoxic pesticides can also cause developmental neurotoxicity**,** at much lower exposure levels (Marina *et.al.,* 2008). Neurological health effects such as memory loss, loss of coordination, reduced speed of response to stimuli, reduced visual ability, altered or uncontrollable mood and general behavior, and reduced motor skills are general outcomes from

pesticides. Other possible health effects include asthma, allergies, and hypersensitivity, and pesticide exposure is also linked with cancer, hormone disruption, and problems with reproduction and fetal development (Gilbert, 2012).Hormonal effects can appear at extremely low dosages that sometimes cannot be observed at higher dose levels. In one study, 37 pesticides out of a group of 134 were tested for their hormonal effects. Out of 37, 23 pesticides were categorized as anti-androgenic and other 7 as androgenic substances (Orton *et.al.*, 2011). If fetuses are exposed to these substances they may suffer developmental disorders and malformations of their sexual organs. Exposure to OP pesticides was assessed in the workers by measuring the pesticide breakdown products in their urine. Aneuploidy is a risk factor for congenital anomalies and other adverse birth outcomes. For example 35% of spontaneous abortions are the result of aneuploidy. This study found a direct association between the increased frequency of sex-null (the lack of a sex chromosome: X or Y) aneuploidy and organophosphate metabolite levels (Emery and Carrell, 2006). In other words, aneuploidy was more common in workers with higher exposures to OP pesticides (Recio *et.al.*, 2001).

IMPACT OF AGROCHEMICALS ON ENVIRONMENTS

Adverse effects on non-target Animal

In Bangladesh biodiversity is declining due to the effect of excess use of pesticide and fertilizer. Population of native fish species is now endangered and the traditional fish-rice systems have disappeared. The bird and other small wild animals are in threat because of the use of pesticides in rice and vegetables. The rice-based agro-ecosystem is showing signs of un-sustainability. Most of the rice farmers (96%) in Comilla district are dependent on insecticides for pest control during dry season, but due to the prevalence of insecticide use, elderly farmers reported that insect pests are now more difficult to control than in their youth (Barzman and Das, 2000). The Brown Plant Hopper (BHP) outbreak in 1991 in Nilphamari and Rangpur districts of Bangladesh has been attributed to the excessive use of pesticides. A survey was conducted in 1999 indicated that, following the aerial spraying cows, calves, goats, fish, honey bees, dragon flies, lady beetles, birds and many other useful insects and animals had been seriously affected (Sultana and Nobukazu, 2001). Khan and Law (2005) have provided an extensive review of the adverse effects of pesticides and other chemicals on the enzyme and hormone systems of fish, amphibians and reptiles. Most fish species are sensitive to enzyme and hormone disruptors. Chronic exposure to low levels of pesticides can produce subtle in behavior and physiology that lead to metabolic disturbances, inhibition of important enzymes, retardation of growth and reduction in the fecundity and longevity. In addition to direct acute toxicity, some herbicides may produce sub-lethal effects on fish that lessen their chances for survival and threaten the population as a whole. Glyphosate or glyphosate-containing products can cause sub-lethal effects such as erratic swimming and labored breathing, which increase the fish's chance of being eaten (Liong *et.al.*, 1988). Herbicides 2,4-D caused physiological stress responses in sockeye salmonand reduced the food-gathering abilities of rainbow trout (Little, 1990).

Adverse effects of non-target plants

Herbicides are designed to kill plants. So it is not surprising that they can injure or kill desirable species if they are applied directly onto them. In addition to killing non-target plants outright, pesticide exposure can cause sub-lethal effects on plants. Phenoxy herbicides, including 2,4-D, can injure nearby trees and shrubs if they drift onto leaves (Dreistadt *et.al.*, 1994). Exposure to herbicide glyphosate can severely reduce seed quality (Locke *et.al.*, 1995). It can also increase the susceptibility of certain plants to disease (Brammall and Higgins, 1988). This poses a special threat to endangered plant species. Plants can also suffer indirect consequences of pesticide application when soil microorganisms and beneficial insects are harmed. Herbicide contamination of water could have also devastating effects on aquatic plants. In one study, oxadiazon was found to severely reduce algal growth (U.S. EPA, 1996).

Adverse effect on microbial community

Heavy treatment of soil with pesticides and other agrochemicals can decline the populations of beneficial soil microorganisms. Overuses of chemical fertilizers and pesticides have effects on the soil organisms that are similar to overuse of antibiotics in human. Indiscriminate use of chemicals might work for a few years, but after a while, there are not enough beneficial soil organisms to hold on to the nutrients. Glyphosate reduces the growth and activity of free-living nitrogen-fixing bacteria in the soil (Santos and Flores, 1995). 2,4-D reduces nitrogen fixation by the bacteria that live on the roots of bean plants (Fabra *et.al.*, 1997). It alsoreduces the growth and activity of nitrogen-fixing blue-green algae (Singh and Singh, 1989) and inhibits the transformation of ammonia into nitrates (Martens and Bremner, 1993).

Water contamination

Although the agricultural soil is the primary recipient of agrochemicals, water bodies that are adjacent to agricultural areas are usually the ultimate recipient for agrochemicals residues. There is a suspicion that agrochemicals residues are common in surface water system, especially in irrigation drains, which ultimately pollute the pond and river water, and can harm aquatic environment (Pereira *et.al.*, 2009). A study of pesticide residues in some selected ponds of Bangladesh showed the residue level of malathion was 0.0241 to 0.463 ppm, carbofuran was 0.0302 to 0.0629 ppm and cypermethrin (pyrethroid) was 0.0141 to 0.09 ppm (Amin-Uddin *et.al.*,2012). The residue level of diazinon and chlorpyriphosin Meherpurregion of Bangladesh ranged from 0.033 to 0.079 ppm and 0.010 to 0.471 ppm, respectively. Among carbamate pesticides, carbofuran was identified from two samples ranged from 0.0143 to 0.0387 ppm . Limit of detection (LOD) was 0.01 ppm in pond water (Amin-Uddin *et.al.*, 2013).

CONCLUSION

Agrochemicals are often considered a quick, easy, and inexpensive solution for controlling weeds and insect pests and increase yield in agricultural landscapes. However, use of pesticide comes at a significant cost. Pesticides have contaminated almost every part of our environment. Pesticide residues are found in soil, surface and ground water across the country and creates severe problem. Pesticide contamination poses significant risks to the environment and non-target organisms ranging from beneficial soil microorganisms to insects, plants, fishes, and birds. The long-term effects of low level exposure to one agrochemical is highly influenced by concomitant exposure to other agrochemicals. Most of the farmers of Bangladesh are not capable of taking decisions on pest management and pesticide application. Often they apply pesticides when there is no real need or they use wrong chemicals at wrong doses, methods and times. As a result, they kill the beneficial organisms easily and create pest resistance causing greater problems and crop losses. Pesticide should be strictly handled according to the regulations which contribute to reduction of the adverse effects of pesticides on human health and environment in Bangladesh. Adoption of a few simple measures such as using good quality sprayers, not smoking during spraying, wearing headgear and changing clothes immediately after spraying may reduce the acute symptoms. For green environment and reducing chronic effect biological solution can play effective role. Biofertilizer is super alternative than chemical fertilizers. Biopesticide also become alternative solution for pest control. IPM and using several natural products and biological agents also give us hope to minimize the adverse effect of agrochemicals.

REFERENCES

Alavanja.M.C.R. 2004. Health Effects of Chronic Pesticide Exposure – Cancer and Neurotoxicity. Annu. Rev. Pub. Healt. 25:155-97

Amin-Uddin.M., M.A. Auwatr, M.A.Z. Chowdhury, M.A. Rahman and M.K. Alam. 2012. pesticide residues in some selected pond water samples of Bangladesh. Bangladesh J. Sci. Res., 25(1):93-98

Amin-Uddin.M., S. Minakshi, M.A.Z. Chowdhury and M.A. Rahman. 2013. Pesticide residues in some selected pond water samples of meherpur region of Bangladesh. J. Asia. Soc. Bang. Sci., 39(1): 77-82

Asogwa, E.U. and L.N. Dongo. 2009. Problems associated with pesticide usage and application in Nigerian cocoa production: A review. Afr. J. Agr. Res., 4: 675-683.

Barzman.M. and L. Das. 2000. Ecologing rice-based systems in Bangladesh. LEISA, ILEIA Newsletter for Low External Input and Sustainable Agriculture 16(4): 16-17.

Bödeker, W. and C. Dümmler. 1993. *Pestizide und Gesundheit*, 2nd ed. Karlsruhe.

Brammall, R.A. and V.J. Higgins. 1988. The effect of glyphosate on resistance of tomato to Fusarium crown and root rot disease and on the formation of host structural defensive barriers. Can. J. Bot., 66:1547-1555.

Chowdhury, F.R., A.U. Rahman, F.R. Mohammed, A. Chowdhury, H.A.M.N. Ahasan and M.A. Bakar. 2011. Acute poisoning in southern part of Bangladesh – The case load is decreasing. Bangladesh Med. Res. Counc. Bull., 37: 61-65

Claude, A., M. Thibaud., E. Patrick., B.Sahabi., S. Onil., S. Louis., D. Sylvain and Benjamin. F. 2012. Characterization of Health and Environmental Risks of Pesticide Use in Market-Gardening in the Rural City of Tori-Bossito in Benin, West Africa. Journal of Environmental Protection, 3:241-248 doi:10.4236/ jep.2012.33030 (http://www.SciRP.org/journal/jep)

Dasgupta, S. and C. Meisner. 2005. Pesticide traders' perception of health risks: evidence from Bangladesh. World Bank Policy Research Working Paper 3777p.

Dreistadt, S.H., J.K. Clark and M.L. Flint. 1994. An integrated pest management guide. University of California Division of Agriculture and Natural Resources; Pests of landscape trees and shrubs. Publication 3359.

Emery, B.R. and D.T. Carrell. 2006. The effect of epigenetic sperm abnormalities on early embryogenesis. Asian J. Andrology., 8.2: 131-42.

Fabra, A., R. Duffard and D.D.A. Evangelista. 1997. Toxicity of 2,4-dichlorophenoxyacetic acid in pure culture. Bull. Environ. Contam.Toxicol., 59:645-652

Gilbert, S.G. 2012.A Small Dose of Pesticides.*A Small Dose of Toxicology*, 2nd ed. Healthy World Press. ISBN: 978-0-9833378-3-6

Gupta, A. 2012. Pesticide use in South and South-East Asia: Environmental Public Health and Legal Concerns. American Journal of Environmental Sciences 8 (2): 152-157 ISSN 1553-345X

Islam, M.A. 2000. Consequences of increased pesticide use. In Huq S. Rahman A. & Conway. G.R, pp. 117-123. (eds.): Environmental Aspects of Agricultural Development in Bangladesh. The University Press, Dhaka, Bangladesh

Khan, Z.M. and F.C.P. Law. 2005. Adverse effects of pesticides and related chemicals on enzyme and hormone systems of fish, amphibians and reptiles: a review. Proc. Pakistan Acad. Sci., 42(4): 315-323.

Liong, P.C., W.P. Hamzah and V. Murugan. 1988. Toxicity of some pesticides towards freshwater fishes. Malaysian Agri. J., 54(3):147-156.

Little, E.E. 1990.Behavioral indicators of sublethal toxicity of rainbow trout. Arch. Environ. Contam. Toxicol., 19:380-385

Locke, D., J.A. Landivar and D. Moseley. 1995. The effects of rate and timing of glyphosate applications of defoliation efficiency, regrowth inhibition, lint yield, fiber quality and seed quality. Proc. Beltwide Cotton Conf., National Cotton Council of America.1088–1090p.

Marina, B.P., R.A. Helle and G. Philippe. 2008. Potential developmental neurotoxicity of pesticides used in Europe. Environmental Health 7:50 doi:10.1186/1476-069X-7-5

Maroni, M., A.C. Fanetti and F. Metruccio. 2006. Risk assessment and management of occupational exposure to pesticides in agriculture. Med. Lav., 97: 430-437.

Martens, D.A. and J.M. Bremner. 1993. Influence of herbicides on transformations of urea nitrogen in soil. J. Environ. Sci. Health. B., 28:377-395.

Orton, F. 2011. Widely Used Pesticides with Previously Unknown Endocrine Activity Revealed as In vitro Antiandrogens. Environ. Health Perspectives 119:794-800

Pereira, J.L., S.C. Antunes., B.B. Castro., C.R. Marques, A.M.M. Gonç-alves., F. Gonç-alves.and R. Pereira 2009. Toxicity evaluation of three pesticides on non-target aquatic and soil organisms: Commercial formulation versus active ingredient. Ecotoxicology 18:455-463.

Pimentel, D. 2005. Environmental and economic costs of the application of pesticides primarily in the United States. Environ. Dev. Sustain., 7: 229-252.

Recio, R., W.A. Robbins, V.B. Aburto, J.M. Martinez, J.R. Froines, 2001. Organophosphorous pesticide exposure increases the frequency of sperm sex null aneuploidy. Environ. Health Perspectives., 12: 1237-1240.

Santos, A. and M. Flores. 1995. Effects of glyphosate on nitrogen fixation of free-living heterotrophic bacteria. Lett. Appl. Microbiol., 20:349-352.

Shadequl-Islam, A.H.M., A. Basher, M. Rashid, M. Islam, S.M. Arif and M.A. Faiz. 2012. pattern of pre-hospital treatment received by cases of pesticide poisoning. Int. J. Med. Toxicol. Foren. Med. 2(3): 88-96.

Singh, J.B. and S. Singh. 1989. Effect of 2,4-dichlorophenoxyacetic acid and maleic hydrazide on growth of bluegreen algae (cyanobacteria) Anabaena doliolum and Anacystisnidulans. Sci. Cult., 55:459–460.

Soares, W.L. and M.F.D. Porto. 2009. Estimating the social cost of pesticide use: An assessment from acute poisoning in Brazil. *Ecol. Econ.*, 68: 2721-2728.

Sultana, P. and N. Nobukazu. 2001. An analysis of pesticide use for rice pest management in Bangladesh. J. of Int. Dev. Coop., 8(1): 107-126.

U.S. EPA. 1996. Office of Prevention, Pesticides, and Toxic Substances. Reregistration eligibility decision (RED): trifluralin. 1996 Washington, D.C., April.