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Review Article

Changing Attitude in Agricultural Practices: Benefits and Hazards of Pesticides in Agriculture

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Abstract: Pesticides are a term used to designate all forms of toxic chemicals used to control pest organisms. Chemicals continue to play a significant role in solving the food and wealth problems of tropical countries. In fact many crops like Cowpeas and Cotton cannot be grown successfully without pesticides application. Malaria eradication all over the world depends largely on the use of pesticides. Pesticides cover a wide range of compounds including insecticides, Acaricides, nematicides, mollucsides, rodenticides, herbicides, fungicides, avecides, bactericide and other. Ideally a pesticide must be lethal to the targeted pests but not to non-targeted organisms, including man. Unfortunately this is not the case, so many controversy of use and abuses of pesticides have surfaced. The rampant and injudicious use of these compounds (Pesticides) has caused havoc in the environment and other animate components of the habitat including human beings.

Keywords: Pesticides, Organophosphate, algaecides, Carbonates, organo-chlorinated, Pyrethroids.

INTRODUCTION

Pesticides have been used as early as 900ad when it was referred to as era of "natural products" (Brown, 2004). The term pesticides cover a wide range of compounds used successfully in controlling a number of pests and diseases (Aktar, *et al.*, 2009). The introduction of organophosphate insecticides in the 1960s, carbamates in 1970s and pyrethroid in 1980s contributed greatly to pest control all over the world. The primary benefits are the consequences of the pesticides effects, the direct gain expected from their use. For example, the effect of killing caterpillars feeding on the crop brings the primary benefit of the higher yields and better quality. The three main effects result in primary benefits ranging from protection of recreational turf to saved human lives. The secondary benefits are the less immediate or less obvious benefits from the primary benefits. They may be subtle, less intuitively obvious, or of longer term. It follows that benefits of pesticide is difficult to establish but nevertheless, there are powerful justification for pesticide use. Not only are pesticides dangerous to the environment, but they are also hazardous to humans health (Adenekan, *et al.*,). They can also affect groundwater by leaching and contaminate the environment. Pesticides can also spread and cause harm by volatilization thereby affecting wildlife. This paper therefore discussed some of the benefits and hazards of pesticides used in agriculture.

Pesticides Improved Productivity

Tremendous benefits have been derived from the use of pesticides in forestry, public health and the domestic sphere and of course, in agriculture, a sector upon which all human lives largely depend. Food grain production, which stood at a mere 50 million tons in 1984, had increased almost fourfold to 198 million tons by the end of 1996-1997 from an estimated 169 million hectares of land.

This result has been achieved by the use of high-yield varieties of seeds, advanced irrigation technologies and agricultural chemicals. Similarly, output and productivity have increased dramatically in most countries. Increased productivity have been due to several factors including the use of fertilizer, better varieties and use of machinery. Pesticides have been an integral part of the process by reducing losses from the weeds, diseases and insect pest that can markedly reduce the amount of harvestable produce. Webster *et*

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al., (1999) stated that "considerable economic losses would be suffered without pesticide use and quantified the significant increase in yield and economic margin that result from pesticide use". Moreover, in the environment, most pesticides undergo photochemical transformation to produce metabolites which are relatively non-toxic to both human beings and the environment (Kole *et al.,* 1999).

Reduction in Crop Losses

In medium land, rice even under puddle conditions during the critical period warranted an effective and economic weed control practice to prevent reduction in rice yield due to weeds that ranged from 28-48%, based on comparison that included control (weedy) plots. Weeds reduce yield of dry land crops by 37-79% (Behera and Singh, 1999). Several infestation of weeds, particularly in the early stage of establishment, ultimately accounts for a yield reduction of 40%. Herbicides provided both an economic and labour benefit.

Control of Vectors of Diseases

Vector-borne diseases are most effectively tackled by killing the vectors. Insecticides, are often the only practical way to control the insects that spread deadly diseases such as malaria, resulting in an estimated 5000 deaths each day (Ross, 2005). In 2004, Bhatia wrote that malaria is one of the leading causes of morbidity and mortality in the developing world and a major public health problem in Africa. Disease control strategies are crucially important also in livestock and plant diseases.

Improved Quality of Food

In countries of the first world, it has been observed that a diet containing fresh fruit and vegetables far outweigh potential risk from eating very low residues of pesticides in crop (Brown, 2004). Increasing evidence shows that eating fruits and vegetables regularly reduces the risk of many carcinogenic, high blood pressure, heart diseases, diabetes, stroke and other chronic diseases.

Pesticides usage has tremendously improved the quality of these agricultural produce. Lewis and Jamie., (2005) discussed the nutritional properties of apple and blueberries in diet and concluded that their high concentrations of anti-oxidants act as protectants against cancer and heart disease. Lewis attributed doubling in wild blueberry production and subsequent increase in consumption chiefly to herbicide use that improved weed control.

Impact of Pesticides on Human Beings

The transport sector makes extensive use of pesticides, particularly herbicides. Herbicides and insecticides are used to maintain the turf on sports, pitches, cricket grounds and golf courses. Insecticides protect buildings and other wooden structures from damage by termites and wood boring insects. Insecticides are also used for fumigation activities to protect the environment and surrounding of dwelling places from insects and pests infestations.

Hazards of Pesticides: The Direct Impact on Humans

If the credits of pesticides include enhanced economic potential in terms of increased production of food and fibre, and amelioration of vector-borne diseases, then their debits have resulted in serious health implications to man and his environment. There is now overwhelming evidence that some of these chemicals do pose a potential risk to human and other life forms and unwanted side effect to the environment (Forget, 1993). No segment of the population is completely protected against exposure to pesticides and the potentially serious health effects through a disproportionate burden is shouldered by the people of developing countries and by high risk groups in each country (WHO, 1990). The world-wide death and chronic diseases due to pesticide poisoning number about one million per year (Kole *et al.,* 1999).

The high-risk group exposed to pesticides include production workers, formulators, sprayers, mixers, loaders and agricultural farm workers. During manufacture and formulation, the possibility of hazard may be higher because the processes involved are not risk free. In industrial settings, workers are at increased risk since they handle various toxic chemicals including pesticides, raw materials, toxic solvents and inert carriers. Organo- chlorinated compounds could pollute the tissue of virtually every life form on the earth, the air, the lakes and the oceans, the fishes that live in them and birds that feed on the fishes(Hurley and Hill, 1998). The magnitude of the toxicity risk involved in the spraying of methonyl, a carbamate insecticide, a field condition was assessed by the National Institute of Occupational Health (NIOH), significantly changes were noticed and the ECG, the serum LDH levels, and cholinesterase activities in the spray man, indicating cardiotoxocic effects of methonyl (Nigam *et al.,* 1993). The US National Academy of Sciences stated that the DDT (Dichloro-diphenyl trichoroethene) metabolite DDE causes egg shell thinning and that the bald eagle population in the U.S declined primarily because of exposure to DDT and its metabolites (liroff, 2000). Certain environmental chemicals, including pesticides termed as endocrine disrupters, are known to elicit their adverse effect by mimicking or antagonising natural hormones in the body and it has been postulated that their long-term, low-dose exposure is increasingly linked to human health effects such as immune suppression hormone distribution diminished intelligence reproductive abnormalities and cancer (Brouwer *et al.,* 1999).

Observation confined to health surveillance in male formulators engaged in production of dust and

liquid formulation of various pesticides (Malathion, Methyl, parathion, DDT and Lindane) in industrial settings of the unorganized sector revealed a high occurrence of generalized symptoms (headache, nausea, vomiting, fatigue, irritation of skin and eyes) besides psychological, neurological, cardiorespiratory and gastrointestinal symptoms coupled with low plasma activity (Gupta *et al*., 1984).

Impact of Pesticides on Food Commodity

The first report of poisoning due to pesticides was from Kerale (India) in 1958, where over 100 people died after consuming wheat flour contaminated with parathion. For determining the extent of pesticide contamination in the food stuffs, programme entitled "Monitoring of Pesticide Residues in Products of Plant Origin" in the European Union started since 1996. In 1996, seven pesticide (acephate, chlopyriphos, chlopyriphos-methyl, methamidophos, iprodiene, procymidone and chlorothalonil) and two groups of pesticides (Benomyl group and maneb group) were analysed in apples, tomatoes, lettuce strawberries and grapes. An average of about 9,700 samples has been analysed for each pesticide or pesticide group. For each pesticide or pesticide group, 5.2% of the sample were found to contain residues and 0.31% had residues higher than the respective MRL for that specific pesticide.

Lettuce was the crop with the highest number of positive results, with residue levels exceeding the MRL's more frequently than in any of the crops investigated. The risk of consumers may then be evaluated by comparison with toxicologically acceptable intake levels (AIL). The average total DDT and BHC consumed by an adult were 19.24mg/day and 77.15mg/day respectively. Fatty foods were the main source of pesticides contaminants (Kannan *et al.*, 1994).

Impact of Pesticides on the Environment

Pesticides can contaminate soil, water, turf and other vegetation. In addition to killing insects or weeds, pesticides can be toxic to a host of other organisms including birds, fish, beneficial insects and non-target plants. Insecticides are generally the most acutely toxic class of pesticides, but herbicides can also pose risk to non-target organisms.

Impact of Pesticides on Surface Water

Pesticides can reach surface water through run-off from treated plants and soil. Contamination of water by pesticides is widespread. The results of a comprehensive set of studies done by the U.S geological survey on major river basins across the country yielded startling results (Kole *et al*., 2001). More than 90 percent of water and fish samples from all streams contained one, or more often, several, pesticides.

Pesticides were found in all samples from major rivers with mixed agricultural and urban land use influences and 99 percent of samples of urban streams (Bortleson and Davis, 1995). According to USGS, in general more pesticides were detected in urban stream than in agricultural streams. The herbicide 2,4-D was the most commonly found pesticide detected in 12 any of 13 streams.

The insecticide diazinon and the weed killer dichlobenil, diuron and glyphosphate were detected at levels exceeding concentration recommended by the National Academy of Sciences for the protection of aquatic life (Bortleson and Davis, 1995).

Contamination of Ground Water

Ground water pollution due to pesticides is a worldwide problem. According to the USGS, at least different pesticides and 21 transformation products have been found in ground water, including pesticides from every major chemical class. Once ground water is polluted with toxic chemicals, it may take many year for the contamination to dissipate or be cleaned up. Clean up may also be very costly and complex, if not impossible.

Contamination of Soil

A large number of transformation products (TPs) from a wide range of pesticides have been documented (Robers, 1998). Persistency and movement of pesticides and the TPs are determined by some parameters such as water solubility. Soil sorbitol constant (KoC), water partition co-efficient (Kow) and half-life in soil (DT50). Pesticides and TPs could be grouped into:

- Hydrophobic Pesticides: Persistent and bio-accumulable pesticides that are strongly bound to soil (i.e. organochlorine, DDT, endosulfan, endrin, heptachlor, lindane and their TPs).
- Polar Pesticides: These are represented mainly by herbicides but they include also carbamates, fungicides and some organophosphorus insecticides TPs. They can be moved from soil by run-off and leaching, thereby constituting a problem for the supply of drinking water to the population.

Effect of Pesticides on Soil Microbes

Heavy treatment of soil with pesticides can cause population of beneficial soil micro-organisms to decline. According to the Soil Scientist, Dr. Elaine Ingham "If we lose both bacteria and fungi then the soil degrades. Overuse of chemicals, fertilizers and pesticides have effects on the soil organisms that are similar to human overuse of antibiotics.

Indiscriminate use of chemicals might work for a few years, but after a while, these become very

toxic to the beneficial soil microbes. For example, plant depend on a variety of soil organisms to transform atmospheric nitrogen into soil nitrates, which plants can use. Common landscape herbicides disrupt this process, for example, triclopyr inhibits soil bacteria that transform ammonia into nitrite (Pell et al., 1998); glyphosate reduces the growth and activity of free-living nitrogen-fixing bacteria in soil. (Santos and ….. 1995) and 2,4-D reduces nitrogen fixation by the bacteria that live on the roots of cowpea plants (Arias and Fabra, 1993).

Effect of Pesticides on Air Pollution

Pesticide sprays can directly hit non-target vegetation or can drift or volatilize from the treated area and contaminate air, soil and non-target plants. Some pesticide drift occurs during every application, even from ground equipment (Glodfelty and Schomburg, 1989).

The toxicity of roundup is likely due to the high toxicity of one of the inert ingredients of the product (Folmar et al., 1979). In addition to direct acute toxicity, some herbicide may produce sub-lethal effects on fish that lessen their chances of survival and threaten the population as a whole. Herbicides can also adversely affect birds by destroying their habitat. Glyphosate treatment in clear cut causes dramatic decrease in the population of birds that lived there (MacKinnan et al., 1993).

Effects of organochlorines on fish eating water birds and marine mammals have been documented in North America and Europe (Cooke, 1979). Despite the continuing usage, little is known about the impacts of organochlorinate compounds on birds' population in developing countries. Similarly, several studies reported in a variety of bio-data including humans and wildlife in Africa. High tissue concentration of dichlorodiphenyldichloroethane (DDE) have been found in bats in Mexico and in the U.S.A. Occurrence of stillbirths in bat exposed to high concentration of DDE pesticides was documented (Clark, 1976).

CONCLUSION

Chemical pesticides provide the best opportunity for agricultural activities because of the extensive benefits which man accrues from their usage. The economic impact of pesticides in non-target species including human beings has been estimated at approximately eight billion annually in developing countries. What is required is to weigh all the risks against the benefits to ensure a maximum margin of safety. The total cost benefit pictured from pesticides use differ appreciably between developed and developing.

For developing countries, it is imperative to use pesticides, as no one would prefer famine and communicable diseases like malaria. It may thus be expedient to accept a reasonable degree of risk. The approach to the use of pesticides should be pragmatic, in other words, all activities concerning pesticides should be based on scientific judgement and not on commercial considerations. There are some inherent difficulties in fully evaluating the risk to human health due to pesticides. The long-term effects of low-level exposure to one pesticide are greatly influenced by concomitant exposure to other pesticides as well as to pollutants present in air, water, foods and drugs.

Pesticides are often considered a quick, easy and inexpensive solution for controlling diseases, weeds and insect pests in urban landscape. Pesticides have contaminated almost every part of our environment. Pesticides residues are found in soil and air, and in surface and ground water across the countries, and urban pesticide uses contribute to the problem. Pesticide contamination poses significant risks to the environment and non-target organisms ranging from beneficial soil micro-organisms to insects, plants, fish and birds. Contrary to common misconception, even herbicides can cause harm to the environment. In fact, weed killers can be especially problematic because they are used in relatively large volumes. The best way to reduce pesticide contamination in our environment is for all of us to do our part to use safer, non-chemical pest control method for our agricultural activities thereby reducing mammalian toxicity and phyto-toxicity.

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