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A project work
on

"TO STUDY THE APPLICATION AND ADVERSE EFFECTS OF PESTICIDES"

Submitted in partial fulfillment for the requirements for the Grade 11 Science in Computer Science

SUBMITTED BY
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Any achievement, be it scholastic or otherwise does not depend solely on the individual efforts but on the guidance, encouragement and cooperation of intellectuals, elders and friends. wewould like to take this opportunity to thank them all.

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DECLARATION

We Aashish Chand, Amrit Pant, Ashish Rai, Dikshyant Bam students of Computer Science of Science group of NAST affiliated to NEB, hereby declare that the work undertaken in this Educational tour entitled "**To Study The Application And Adverse Effects Of Pesticides**" is the outcome of our own effort and is correct to the best of our knowledge. This work has been accomplished by obeying the social ethics; and it contains neither materials published earlier or written by another person/people nor materials which has been accepted for the award of any other degree of the school or other institution, except where due acknowledgement has been made in the document.

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CERTIFICATE

This is to certify that the report entitled "**To Study The Application And Adverse Effects Of Pesticides**" is a report of the work carried out by our group under the guidance and supervision of Mr.DB Khadka for the partial fulfilment of secondary school grade XI certificate level degree of Computer Science by National Examination Board.

To the best of our knowledge and belief, this work embodies the work of candidates themselves, has duly been completed, fulfils the requirement of the ordinance relating to the Grade XI degree of the school and is up to the standard in respect of content, presentation and language for being referred to the examiner.

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INTRODUCTION AND ITS HISTORY

Pesticides are chemical substances that are meant to kill pests. In general, a pesticide is a chemical or a biological agent such as a virus, bacterium, antimicrobial, or disinfectant that deters, incapacitates, kills, pests.

This use of pesticides is so common that the term pesticide is often treated as synonymous with plant protection product. It is commonly used to eliminate or control a variety of agricultural pests that can damage crops and livestock and reduce farm productivity. The most commonly applied pesticides are insecticides to kill insects, herbicides to kill weeds, rodenticides to kill rodents, and fungicides to control fungi, mould, and mildew. Pesticides are not recent inventions. Many ancient civilizations used pesticides to protect their crops from insects and pests. Ancient Sumerians used elemental sulfur to protect their crops from insects. Whereas, Medieval farmers experimented with chemicals using arsenic, lead on common crops.

The Chinese used arsenic and mercury compounds to control body lice and other pests. While the Greeks and Romans used oil, ash, sulfur, and other materials to protect themselves, their livestock, and their crops from various pests.

Meanwhile, in the nineteenth century, researchers focused more on natural techniques involving compounds made with the roots of tropical vegetables and chrysanthemums. In 1939, Dichloro-Diphenyl-Trichloroethane (DDT) was discovered, which has become extremely effective and rapidly used as the insecticide in the world.

TYPES OF PESTICIDES

Grouped by Types of Pests They Kill

1. Insecticides – insects
2. Herbicides – plants
3. Rodenticides – rodents (rats & mice)
4. Bactericides – bacteria
5. Fungicides – fungi
6. Larvicides – larvae

Based on how biodegradable they are:

Pesticides can also be considered as:

- **Biodegradable:** The biodegradable kind is those which can be broken down by microbes and other living beings into harmless compounds.
- **Persistent:** While the persistent ones are those which may take months or years to break down.

Another way to classify these is to consider those that are chemical forms or are derived from a common source or production method.

Chemically-related pesticides:

- Organophosphate:

  Most organophosphates are insecticides, they affect the nervous system by disrupting the enzyme that regulates a neurotransmitter.

- Carbamate:

  Similar to the organophosphorus pesticides, the carbamate pesticides also affect the nervous system by disrupting an enzyme that regulates the neurotransmitter. However, the enzyme effects are usually reversible.

- Organochlorine insecticides:

  They were commonly used earlier, but now many countries have been removed Organochlorine insecticides from their market due to their health and environmental effects and their persistence (e.g., DDT, chlordane, and toxaphene).

- Pyrethroid:

  These are a synthetic version of pyrethrin, a naturally occurring pesticide, found in chrysanthemums(Flower). They were developed in such a way as to maximise their stability in the environment.

- Sulfonylurea herbicides:

  The sulfonylureas herbicides have been commercialized for weed control such as pyrithiobac-sodium, cyclosulfamuron, bispyribac-sodium, terbacil etc.

APPLICATIONS OF PESTICIDES

Pesticide application refers to the practical way in which pesticides (including herbicides, fungicides, insecticides, or nematode control agents) are delivered to their biological targets (*e.g.* pest organism, crop or other plant). Public concern about the use of pesticides has highlighted the need to make this process as efficient as possible, in order to minimise their release into the environment and human exposure (including operators, bystanders and consumers of produce). The practice of pest management by the rational application of pesticides is supremely multi-disciplinary, combining many aspects of biology and chemistry with: agronomy, engineering, meteorology, socio-economics and public health, together with newer disciplines such as biotechnology and information science.

Seed treatments

Seed treatments can achieve exceptionally high efficiencies, in terms of effective dose-transfer to a crop. Pesticides are applied to the seed prior to planting, in the form of a seed treatment, or coating, to protect against soil-borne risks to the plant; additionally, these coatings can provide supplemental chemicals and nutrients designed to encourage growth. A typical seed coating can include a nutrient layer—containing nitrogen, phosphorus, and potassium, a rhizobial layer—containing symbiotic bacteria and other beneficial microorganisms, and a fungicide (or other chemical) layer to make the seed less vulnerable to pests.

Spray application

One of the most common forms of pesticide application, especially in conventional agriculture, is the use of mechanical sprayers. Hydraulic sprayers consists of a tank, a pump, a lance (for single nozzles) or boom, and a nozzle (or multiple nozzles). Sprayers convert a pesticide formulation, often containing a mixture of water (or another liquid chemical carrier, such as fertilizer) and chemical, into droplets, which can be large rain-type drops or tiny almost-invisible particles. This conversion is accomplished by forcing the spray mixture through a spray nozzle under pressure. The size of droplets can be altered through the use of different nozzle sizes, or by altering the pressure under which it is forced, or a combination of both. Large droplets have the advantage of being less susceptible to spray drift, but require more water per unit of land covered. Due to static electricity, small droplets are able to maximize contact with a target organism, but very still wind conditions are required.

Spraying pre- and post-emergent crops

Traditional agricultural crop pesticides can either be applied pre-emergent or post-emergent, a term referring to the germination status of the plant. Pre-emergent pesticide application, in conventional agriculture, attempts to reduce competitive pressure on newly germinated plants by removing undesirable organisms and maximizing the amount of water, soil nutrients, and sunlight available for the crop. An example of pre-emergent pesticide application

is atrazine application for corn. Similarly, glyphosate mixtures are often applied pre-emergent on agricultural fields to remove early-germinating weeds and prepare for subsequent crops. Pre-emergent application equipment often has large, wide tires designed to float on soft soil, minimizing both soil compaction and damage to planted (but not yet emerged) crops. A three-wheel application machine, such as the one pictured on the right, is designed so that tires do not follow the same path, minimizing the creation of ruts in the field and limiting sub-soil damage.

Post-emergent pesticide application requires the use of specific chemicals chosen to minimize harm to the desirable target organism. An example is 2,4-Dichlorophenoxyacetic acid, which will injure broadleaf weeds (dicots) but leave behind grasses (monocots). Such a chemical has been used extensively on wheat crops, for example. A number of companies have also created genetically modified organisms that are resistant to various pesticides. Examples include glyphosate-resistant soybeans and Bt maize, which change the types of formulations involved in addressing post-emergent pesticide pressure. It was important to also note that even given appropriate chemical choices, high ambient temperatures or other environmental influences, can allow the non-targeted desirable organism to be damaged during application. As plants have already germinated, post-emergent pesticide application necessitates limited field contact in order to minimize losses due to crop and soil damage. Typical industrial application equipment will utilize very tall and narrow tires and combine this with a sprayer body which can be raised and lowered depending on crop height. These sprayers usually carry the label 'high-clearance' as they can rise over growing crops, although usually not much more than 1 or 2 meters high. In addition, these sprayers often have very wide booms in order to minimize the number of passes required over a field, again designed to limit crop damage and maximize efficiency. In industrial agriculture, spray booms 120 feet (37 meters) wide are not uncommon, especially in prairie agriculture with large, flat fields. Related to this, aerial pesticide application is a method of top dressing a pesticide to an emerged crop which eliminates physical contact with soil and crops.

Air Blast sprayers, also known as air-assisted or mist sprayers, are often used for tall crops, such as tree fruit, where boom sprayers and aerial application would be ineffective. These types of sprayers can only be used where overspray—spray drift—is less of a concern, either through the choice of chemical which does not have undesirable effects on other desirable organisms, or by adequate buffer distance. These can be used for insects, weeds, and other pests to crops, humans, and animals. Air blast sprayers inject liquid into a fast-moving stream of air, breaking down large droplets into smaller particles by introducing a small amount of liquid into a fast-moving stream of air.

Foggers fulfill a similar role to mist sprayers in producing particles of very small size, but use a different method. Whereas mist sprayers create a high-speed stream of air which can travel significant distances, foggers use a piston or bellows to create a stagnant area of pesticide that is often used for enclosed areas, such as houses and animal shelters.

Herbicide volatilisation

Herbicide volatilisation refers to evaporation or sublimation of a volatile herbicide. The effect of gaseous chemical is lost at its intended place of application and may move downwind and affect

other plants not intended to be affected causing crop damage. Herbicides vary in their susceptibility to volatilisation. Prompt incorporation of the herbicide into the soil may reduce or prevent volatilisation. Wind, temperature, and humidity also affect the rate of volatilisation with humidity reducing in. 2,4-D and dicamba are commonly used chemicals that are known to be subject to volatilisation but there are many others. Application of herbicides later in the season to protect herbicide-resistant genetically modified plants increases the risk of volatilisation as the temperature is higher and incorporation into the soil impractical.

Improved targeting

The technologies such as controlled droplet application (CDA) received extensive research interest, but commercial uptake has been disappointing. By controlling droplet size, ultra-low volume (ULV) or very low volume (VLV) application rates of pesticidal mixtures can achieve similar (or sometimes better) biological results by improved timing and dose-transfer to the biological target (i.e. pest). No atomizer has been developed able to produce uniform (monodisperse) droplets, but rotary (spinning disc and cage) atomizers usually produce a more uniform droplet size spectrum than conventional hydraulic nozzles (see: CDA & ULV application equipment). Other efficient application techniques include: banding, baiting, specific granule placement, seed treatments and weed wiping

CDA is a good example of a rational pesticide use (RPU) technology (Bateman, 2003), but unfortunately has been unfashionable with public funding bodies since the early 1990s, with many believing that all pesticide development should be the responsibility of pesticide manufacturers. On the other hand, pesticide companies are unlikely widely to promote better targeting and thus reduced pesticide sales, unless they can benefit by adding value to products in some other way. RPU contrasts dramatically with the promotion of pesticides, and many agrochemical concerns, have equally become aware that product stewardship provides better long-term profitability than high pressure salesmanship of a dwindling number of new “silver bullet” molecules. RPU may therefore provide an appropriate framework for collaboration between many of the stake-holders in crop protection.

Understanding the biology and life cycle of the pest is also an important factor in determining droplet size. The Agricultural Research Service, for example, has conducted tests to determine the ideal droplet size of a pesticide used to combat corn earworms. They found that in order to be effective, the pesticide needs to penetrate through the corn's silk, where the earworm's larvae hatch. The research concluded that larger pesticide droplets best penetrated the targeted corn silk. Knowing where the pest's destruction originates is crucial in targeting the amount of pesticide needed.

EFFECTS OF PESTICIDES

Pesticide has both beneficial and harmful effect for human and environment.

a) Beneficial Effects

i) Improve production and productivity of agriculture commodity to feed the ever growing population.

ii) Control vector borne disease like malaria and reduce mortality and morbidity and make better place to live, and

iii) Other like sports (cricket ground, golf lawn), road, building (against termites) etc.

b)Harmful Effects

Pesticides are designed to kill pests, but some pesticides can also cause negative health effects in people and damage ecosystem. Pesticide residues absorbed by inhalation, ingestion, and dermal contact can lead to acute and chronic toxicity. Such kinds of the toxicity depend on types of pesticides, port of entry, dose, metabolism, accumulation and so on. Acute toxicity is due to short-term exposure and happens within a relatively short period of time, whereas chronic toxicity is due to repeated or long-term exposure and happens over a longer period. Mainly it interrupts the metabolic and systemic functions of the human body. The chemical compound of pesticide disrupts the neurological function. It is injurious to the immune and endocrine systems as well (Wesseling, et al., 1997). Wide use of these pesticides can cause both acute and chronic adverse health effects in human. Studies in the past have revealed the association of organochlorine and organophosphate with diabetes mellitus (Paudayl, 2008). Organophosphate inhibits the neurotransmitter acetyl cholinesterase and can affect the central and autonomic nervous system. Few leading symptoms related to the autonomic nervous system are abdominal cramps; nausea, diarrhea, salivation, miosis and symptoms related to the central nervous system are dizziness, tremor, anxiety, and confusion. Symptoms usually occur within hours of exposure and typically disappear within days or weeks as new cholinesterase is synthesized (Aryal et.al., 2016). In many developing countries like Nepal, most pesticides are associated with adverse effects on human health and environment due to inappropriate use and handling of pesticides by inadequately trained farm workers (Naidoo et al., 2010). Majority of pesticides users, being unaware of pesticide types, their mode of action, potential hazards and safety measures, and the problem is becoming more havoc. The pesticides are widely applied in agriculture sector of Nepal. Farmer had considerable knowledge regarding health impacts of pesticide; however, they did not adopt the safety precaution resulting higher risk of exposure with pesticide intoxication. As a result, nearly 51% farmers experienced an acute toxicity syndrome of pesticides and one of ten farmers reported several kinds of chronic diseases of which 24% farmers had chronic neuropathic diseases (Aryal et.al., 2016).

The other major harmful effects of pesticide in human and environment are:

c)Direct impact on human

The credits of pesticides include enhanced economic potential in terms of increased production of food and fiber, and management of vector-borne diseases, and then their debits have resulted in serious health implications to man and environment. There is now overwhelming evidence that some of these chemicals do pose a potential risk to humans and other life forms and unwanted side effects to the environment (Forget, 1993; Igbedioh, 1991; Jeyaratnam, 1981 cited in Aktar et.al., (2009)). No segment of the population is completely protected against exposure to pesticides and the potentially serious health effects. Accurate statistics on health effects of pesticides are not available. However, it is estimated that globally, every year, between 1 and 41 million people suffer from exposure to pesticides (PAN International, 2007).WHO (2009) estimated that a minimum of 300,000 people die from pesticide poisoning each year, with 99% of them from low- and middle- income countries. In 2008, the World Bank put the number of deaths at 355,000. However, FAO (2005) referring to recent data from Sri Lanka indicated that 300,000 deaths per year may occur in the Asia-Pacific region alone due to pesticide poisoning.The epidemiology of pesticide exposure globally is not fully understood and most of the time underdiagnosed, according to the Pan American Health Organization, an international public health agency based in Washington, D.C. “Pesticide poisoning cases are under-reported by 50 percent to 80 percent regionwide,” reported the PAHO in 2011, referring to the Americas.

d)Impact on environment

Pesticides have severe impact on environment too. Some are mentioned below:

i) Surface and ground water contamination:

Pesticides are included in a broad range of organic micro pollutants that have ecological impacts. Different categories of pesticides have different types of effects on living organisms, therefore generalization is difficult. Although terrestrial impacts by pesticides do occur, the principal pathway that causes ecological impacts is that of water contaminated by pesticide runoff. The two principal mechanisms are bio concentration and bio magnification. Bio concentration: This is the movement of a chemical from the surrounding medium into an organism. The primary "sink" for some pesticides is fatty tissue ("lipids"). Some pesticides, such as DDT, are "lipophilic", meaning that they are soluble in, and accumulate in fatty tissue such as edible fish tissue and human fatty tissue. Other pesticides such as glyphosate are metabolized and excreted. Bio magnification: This term describes the increasing concentration of a chemical as food energy is transformed within the food chain. As smaller organisms are eaten by larger organisms, the concentration of pesticides and other chemicals are increasingly magnified in tissue and other organs. Very high concentrations can be observed in top predators, including man. The ecological effects of pesticides and other organic contaminants are varied and are often inter-related.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. Ecological effects of pesticides extend beyond individual organisms and can extend to ecosystems. Swedish work indicates that application of pesticides is thought to be one of the most significant factors affecting biodiversity. WWF reports that the increased rate of disease, deformities and tumors in commercial fish species in highly polluted areas of the North Sea and coastal waters of the United Kingdom since the 1970s is consistent with effects known to be caused by exposure to pesticides (FAO, 1996). Pesticides can reach surface water through runoff 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 (USGS) on major river basins across the USA in the early to mid- 90s have shown the alarming situation that is more than 90 percent of water and fish samples from all streams contained one, or more often, several pesticides (Kole et al., 2001). Similarly, groundwater pollution due to pesticides is a worldwide problem. According to the USGS, at least 143 different pesticides and 21 transformation products have been found in ground water, including pesticides from every major chemical class . During one survey in India, 58% of drinking water samples drawn from various hand pumps and wells around Bhopalwere contaminated with Organo Chlorine pesticides above the EPA standards (Kole and Bagchi, 1995 cited in Aktar et al., 2009). Once ground water is polluted with toxic chemicals, it may take many years for the contamination to dissipate or be cleanedup. Cleanup may also be very costly and complex, if notimpossible (Waskom 1994; O'Neil, 1998; US EPA, 2001 cited in Aktar et al.,2009).

ii) Soil contamination

Different pesticides used in soil treatment and also large number of transformation products (TPs) from a wide range of pesticides can cause populations of beneficial soil microorganisms to decline. According to the soil scientist Dr. Elaine Ingham, "If we lose both bacteria and fungi, then the soil degrades. Overuse of chemical 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, there aren't enough beneficial soil organisms to hold onto the nutrients" (Savonen, 1997). The loss of beneficial microorganisms in soil will cause low fertility of the soil and will be responsible for poor production and productivity of crops. And it ultimately reduces the farm income and enhances hunger and poverty.

iii) Contamination of air and non-target vegetation:

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 (Glotfelty and Schomburg, 1989). Drift can account for a loss of 2 to 25% of the chemical being applied, which can spread over a distance of a few yards to several hundred miles.

Conclusion

Pesticides are often considered a quick, easy, and inexpensive solution for controlling weeds and insect pests in agriculture, public health and other areas. However, pesticide use comesat a significant cost. Pesticides have contaminated almost every part of our environment. Pesticide residues are found in soil and air, as well as in surface and ground water across the countries, and contamination poses significant risks to the human health as well as environment and non-target organisms ranging from beneficial soil microorganisms to insects, plants,fish and birds. Since 1950s, pesticides have been used for increasing the agricultural productivity and safeguarding the public health in Nepal. Every year the consumption of pesticide for agriculture purpose is increasing. Though the quantity of consumption per hectare in agricultural field is very low comparing with other countries of the globe but due to haphazard use of pesticide in some commodity and ignorance of waiting period after its application has increased the exposure of farm families to pesticides and intake of pesticides by consumers, which are becoming major health threat. Injudicious and indiscriminate use of pesticides and presence of pesticide residues in food, fruits, vegetables and environment is a matter of grave-concerns in our context. To sum up, based on our limited knowledge of direct and/or inferential information, the domain of pesticides illustrates a certain ambiguity in situations in which people are undergoing life-long exposure. There is thus every reason to develop health education packages based on knowledge, aptitude and practices and to disseminate them within the community in order tominimize human exposure to pesticides. Taking into consideration the health and environmental effects of chemical pesticides, it is clear that the need for a new concept in agriculture is urgent. This new concept must be based on a drastic reduction in the application of chemical pesticides, which can result in health, environmental, and economic benefits to the public.

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