# A Glance at Pesticides Usage: Remunerations and Complications Associated with Insecticides Putting in Practice

**Muhammad Sarwar**

Department of Entomology, Nuclear Institute for Food & Agriculture (NIFA), Tarnab, Peshawar, Pakistan; E-mail: drmsarwar64@yahoo.com

## Abstract

Pesticide poisoning may be obvious and every family member, co-worker and applicator should know about remunerations and complications associated with insecticides exposure. Here, this article addresses both virtues and shortcomings associated with insecticides usages. There are many kinds of benefits that may be attributed to pesticide uses, but these benefits often go unnoticed by the general public. Pesticides are widely used in most sectors of agricultural production to prevent or reduce losses by pests and thus can improve yield as well as quality of produce, which is often appealed to consumers. Pesticides can also improve nutritional value of food and sometimes its safety, and thus from this point of view, pesticides can be considered as an economic, labor-saving, and efficient tool of pest management needs with great popularity in most sectors of agricultural production. Insecticide-treated seeds are applied directly to soil which limit quantity of pesticide used; provide targeted protection of crops against insects; and reduce potential exposure of non-target organisms, such as humans and beneficial insects to insecticide. Even though pesticides are intended to harm only target pests, if not used correctly, they can also harm peoples or environment. As with all toxic substances, exposure causing harm depends on the dose, how someone is exposed, how sensitive an individual may be to that toxin, and toxicity of pesticide involved. Insecticides are examined for a wide variety of toxic effects from dermal, oral to respiratory exposure and such effects include carcinogenicity (produce cancer or to assist carcinogenic chemicals), mutagenicity (genetic changes, teratogenicity (birth defects), oncogenicity (induce tumor growth- not necessarily cancers), liver damage (death of liver cells, jaundice- yellowing of the skin, fibrosis and cirrhosis), reproductive disorders (reduced sperm count, sterility and miscarriage), nerve damage (accumulative effects on cholinesterase depression associated with organophosphate insecticides) and allergenic sensitization (development of allergies to pesticides or chemicals used in formulation of pesticides). Current article emphasizes on expansion of novel pesticides with innovative modes of action, better safety profiles and execution of alternative cropping systems which are less reliant on pesticides to curtail exposure to pesticides and undesirable effects of exposure on human health. Additionally, use of suitable and well-maintained spraying equipment along with taking all securities required in all stages of pesticide handling could also decrease exposure to pesticides. The inclusive optimization of pesticide supervision sternly according to regulations and also considering public concerns about pesticide residues in food and drinking water could contribute to reduction of adverse effects of pesticides on human health, environment, and safe food production within a viable agricultural production system.

**Keywords:** Ecosystem service, Pesticide toxicity, Pesticide safety, Pesticide risk

## 1. Introduction.

Pesticides are chemicals that kill or manage the population of pests throughout the world. There are many different types of pesticides on the market today, but the most common are herbicides, fungicides and insecticides, which kill or manage unwanted plants, pathogens and insects. Pesticides used worldwide to manage agricultural pests kill and repel unwanted pests, but also cause many human expiries each year. The presence of a pesticide in the environment is not necessarily a problem, but it may be a source of exposure to poisons. The insecticides cause harm to health, the amount needed to cause harm depends on the chemical, and with most pesticides, the longer a person is exposed the greater the chances of harm are there. Peoples can be exposed by breathing a pesticide, getting it into the mouth (by eating or drinking), or by contact with the skin or eyes. Some peoples are more at risk than others, depending on their age, gender, individual sensitivity, or other factors. Risk from the use of pesticides depends on two things; the toxicity of the pesticide, and the amount of exposure. In other words, Risk = Toxicity × Exposure. Toxicity can range from low to high, and can vary depending on the route of exposure. The exposure takes place when a pesticide is breathed in, touches the skin, or gets eaten by humans (Sarwar, 2015 a; 2015 b). The message in this article explores the widespread use of pesticides in agriculture and compares the benefits and problems associated with these caring but hazardous chemicals.

## 2. Use of Pesticides

As the human population increases, the amount of food produced is very important. The main goals of agriculture are to developed and produce crops and livestock for human consumption. Unfortunately, there are other organisms that want to consume the crops that are meant for humans. It is estimated that nearly 37% of all crops produced are destroyed by agricultural pests, which results in an economic loss of around billions of dollars in a year. Due to this high loss in food production, pesticides are often used to try to combat the problem. The damage caused by agricultural pests is a global problem, and over the past half-century, the amount of pesticides used has increased fourfold. The toxicity of a pesticide, its formulation, and how much peoples touch, eat, or breathe in, are all important considerations. The likelihood of experiencing some health effect as a result of using a product is referred to as the pesticide risk. The risk of any pesticide use depends on which type of pesticide is used, how much pesticide is applied, how often the pesticide is applied, and who or what have contacts with the pesticide (Sarwar, 2015 c; 2015 d).

### 2.1. Pesticide Exposure

The chance of developing a health problem from a pesticide depends on two things; the toxicity of the pesticide and the amount of exposure. In order for a pesticide to affect a person, one must be exposed to the pesticide by some routes such as eating (ingestion), breathing (inhalation), or getting it on the skin or in eyes (dermal exposure). Even if a very toxic pesticide is used near the home, the risk may still be low. If a person in not exposed to the pesticide, it cannot harm anyone. In some cases, a pesticide can be used without any person coming into contact with it at all (Sarwar and Salman, 2015 a).

### 2.2. Pesticide Toxicity

To help peoples in understanding the toxicity of products, pesticides are classified in groups from low to high toxicity. Because the risk or chance of a problem depends on both the toxicity and the amount of exposure, even pesticides that are low in toxicity can be hazardous if the exposure is high. Over the last so many years, the widespread use of pesticides has resulted several benefits and also caused many problems (Sarwar and Salman, 2015 b).

## 3. Benefits of Pesticides

The benefits of pesticides include increased food production, increased profits for farmers and the prevention of pests and diseases. Although pests consume or harm a large portion of agricultural crops, without the use of pesticides, it is likely that they would consume a higher percentage of produce. Due to the use of pesticides, it is possible to combat pests and produce larger quantities of food. By producing more crops, farmers are also able to increase profits by having more produce to sell. Pesticides also increase farm profits by helping the farmers to save money on labor costs. Using of pesticides reduces the amount of time required to manually remove weeds and pests from fields. Pesticides widely used in most sectors of the agricultural production, prevent or reduce losses by pests and thus can improve yield as well as quality of the produce, which is often important to appeal consumers. Pesticides can also improve the nutritional value of food and sometimes its safety. There are also many other kinds of benefits that may be attributed to pesticides, but these benefits often go unnoticed by the general public. Thus, from this point of view, pesticides can be considered as an economic, labor-saving, and efficient tool of pest management with great popularity in most sectors of the agricultural production (Oerke and Dehne, 2004; Damalas, 2009).

In addition to saving crops and livestock, pesticides have also direct benefits to human health. It is estimated that the use of pesticides has prevented the deaths of around seven million peoples by killing pests that carry or transmit diseases to humans. Malaria, which is transmitted by infected mosquitoes, is one of the most commonly known and deadly diseases that has decreased in prevalence due to the use of pesticides. Other diseases that were minimized due to the use of pesticides include the bubonic plague, which is carried by rat fleas, and typhus which is transmitted by both fleas and body lice (Cooper and Dobson, 2007; Sarwar, 2014; 2015 e; 2015 f; 2015 g**)**.

## 4. Benefits of Insecticide Treated Seeds

Insecticide-treated seeds have been in use for about decades and farmers choose to use them because they provide valuable protection to crops during their early stages of development, which results in healthier plants, fewer spray applications, and increased yields. Farmers are used to have a spray an entire field with an insecticide to fend off pests. Insecticide-treated seeds are applied directly to the soil which limit the quantity of pesticide used; provide targeted protection of crops against insects, and reduce potential exposure of non-target organisms, such as humans and beneficial insects to the insecticide. Insecticide-treated seeds also make it possible for farmers to adopt practices that can decrease greenhouse gas emissions and enrich soil health such as conservation tillage and the planting of cover crops. These cover crops can in turn provide valuable pollinator-friendly forage. When farmers use insecticide-treated seed, they follow best management practices to reduce the exposure of dust to non-target and beneficial insects, like

bees and natural enemies (Akbar et al., 2005; Sarwar et al., 2007; Sarwar, 2013). These superlative management practices for planting insecticide-treated seeds and using this information to inform planting decisions include:-

i. Provision to the pollinators the friendly habitats away from active fields prior to planting, so that bees are not attracted to the field for foraging.
ii. Use of a fluency agent as a seed box lubricant, instead of talc or graphite, reduces dust emissions during planting.
iii. Dry and windy conditions can carry dust into flowering crops, weeds, or trees, thus increasing potential exposure of bees to dust treatment material.
iv. Being aware of wind direction when planting a field near flowering crops, weeds or trees, monitor environmental conditions and be aware of bee hive locations.
v. Handling and loading treated seeds carefully avoid the generating of dust, so always properly clean-up and dispose of treated seed and empty seed bags.

## 5. Problems Associated With Pesticides

Although there are benefits to the use of pesticides, there have also been many problems associated with their usage. When pesticides are used, they do not always stay in the location where they are applied. They are mobile in the environment and often move through water, air and soil. The problem with pesticide mobility is that when they travel, the pesticides come in contact with other organisms and can cause harm to them (Sarwar and Salman, 2015 c). Here are addressed some shortcomings through use of pesticides:-

Although invertebrates generally have a low public profile, for instance, honey bee, *Apis mellifera* L., is a flagship species whose popularity likely derives from the products it provides and its perceived ecological services. Therefore, the raging debate regarding honey bee decline has surpassed the realm of beekeepers, academia, industry and regulatory agencies and now also encompasses non-governmental agencies, media, fiction writers and the general public. The early interest and concern about honey bee colony collapse disorder soon shifted to the bigger issue of pollinator decline, with a focus on the potential involvement of pesticides in such a phenomenon. Pesticides have been previously recognized as the potential culprits of the reported declines, particularly the neonicotinoid insecticides owing to their widespread and peculiar use in agriculture. However, the evidence for the potential pivotal role of these neonicotinoids in honey bee decline remains a matter of debate, with an increased recognition of the multifactorial nature of the problem and the lack of a direct association between the noted decline and neonicotinoid use. The focus on the decline of honey bee populations subsequently spreads to other species, and bumblebees became another matter of concern. Other bee species, ones that are particularly important in many regions of the world, remain the object of little concern (unjustifiably so). Furthermore, the continuous focus on neonicotinoids is also in need of revision, as the current evidence suggests that a broad spectrum of compounds deserve attention (Barbosa et al., 2015). Despite their popularity and extensive use, pesticides serious concerns about health risks arising from the exposure of farmers when mixing and applying pesticides or working in treated fields, and from residues on food and in drinking water for the general population have been raised. The insecticides have been examined for a wide variety of toxic effects from dermal to oral respiratory exposure (Wilson and Tisdell, 2001; Maroni et al., 2006; Soares and Porto, 2009) and such effects include:-

i. **Carcinogenicity**- It is an ability to produce cancer or to assist carcinogenic chemicals.
ii. **Mutagenicity**- It is a capability to cause genetic changes.
iii. **Teratogenicity**- This is a capacity to cause birth defects.
iv. **Oncogenicity**- This is an aptitude to induce tumor growth (not necessarily cancers).
v. **Liver damage**- It involves death of liver cells, jaundice (yellowing of the skin), fibrosis and cirrhosis.
vi. **Reproductive disorders**- It encompasses such as reduced sperm count, sterility and miscarriage.
vii. **Nerve damage**- This is including accumulative effects on cholinesterase depression associated with organophosphate insecticides.
viii. **Allergenic sensitization**- It is a development of allergies to pesticides or chemicals used in formulation of pesticides.

Pesticides have also been shown to disrupt the balance of an ecosystem and in many situations when a pesticide is used, it also kills non-pest organisms. This can drastically alter the natural balance of the ecosystem wherein by removing non-pest organisms; the environment can be changed to favor the pest. In addition to causing harm to wildlife, pesticides that travel from their original location are known to cause harm to humans. Human exposure to pesticides has caused poisonings, the development of cancer and the deaths of thousands of peoples worldwide each year. Another major problem associated with pesticide use is bioaccumulation and biological magnification. Bioaccumulation occurs when a substance builds up in the body because the body does not have the proper mechanisms to remove it. Many synthetic pesticides are not able to be broken down. Once they enter the body of an organism and these are permanently stored in the body tissue. The pesticides that accumulate in an organism's body can cause harm to the organism or can be passed on to a predator. Due to the fact that the pesticides are integrated into the tissue of an organism, when it is consumed by a predator, the pesticides are transferred to that organism. As the predator consumes more exposed individuals, the concentration of pesticides in its own body can increase (Berny, 2007; Sarwar et al., 2014; Mughal et al., 2015; Sarwar et al., 2015).

Organisms that are higher in the food chain might have increased concentrations of pesticides because they consumed many lower level organisms and received the pesticides stored in those organisms. Biological magnification, also known as bio-magnification, is the term used to describe when chemicals, while in this case pesticides, increase in concentration with each level of the food chain. A famous example of bio-magnification is with the pesticide known as DDT, which has been used to kill mosquitoes and sprayed on crops to kill pests. This pesticide got into the water supply and has been integrated into the bodies of zooplankton, which have been then consumed by small fish and then larger fish. Eventually, the larger fish have been eaten by predatory birds, and due to the bio-magnification of the pesticide, the birds became killed by the large concentration of pesticides that accumulated in their bodies. This led to the near extinction of several predatory birds, including the bald eagle and peregrine falcon. In particular, microbes, invertebrates and fish play critical roles as decomposers, pollinators, consumers, and predators, which collectively maintain healthy communities and ecosystem integrity. Several examples have been demonstrated the evidence of negative impacts of systemic insecticides on decomposition, nutrient cycling, soil respiration and invertebrate populations valued by humans (Chagnon et al., 2015). Genetic resistance is one problem

associated with pesticide use that has become more of an issue over the years. Genetic resistance occurs when a species genetic makeup changes over generations and results in becoming the species resistant to something that is used to cause it harm. In relation to pesticide use, genetic resistance has occurred in many pests over the years, especially insects. Relying on pesticide tolerance and the selection of resistance traits or a functional resilience of ecosystem communities as justification for the continued widespread and often prophylactic use of systemic insecticides would be a perilous strategy for maintenance of ecosystem services (Kohler and Triebskorn, 2013).

## 6. Understanding Pesticide Risks

Voluminous of peoples consider that some pesticides are safe, while others are dangerous. Actually, the words ‘safe’ and ‘dangerous’ are misleading, and any chemical, including a pesticide, can pose risks to peoples, pets, or the environment. Understanding pesticide risk will help to take steps to minimize it. The risk of a pesticide depends on two things, exposure (how much) and toxicity (how poisonous). The exposure is the quantity an individual gets in or on body, or the extent that is released into the environment. The toxicity of a pesticide is measure of how poisonous it is to peoples or the environment. Even products that are low in toxicity can be hazardous if the exposure is high enough. This is the basis for the argument that the dose makes the poison. For example, one aspirin is beneficial for pain or certain medical conditions, but too much aspirin could be very hazardous. As the amount of exposure (the dose) to pesticide increases, so does the risk. Pesticides often contain more than one ingredient and each one may have a different toxicity. One easy way to estimate the toxicity of a pesticide product is to look at the signal word. Most pesticides will have either the word Caution (lower toxicity products), Warning (medium toxicity products), or Danger (highest toxicity products) on the label, and that signal word reflects the toxicity of the product (Sarwar, 2015 h; 2015 i; 2015 j).

### 6.1. Pests Managing and Pesticide Choosing

Identify the pest and the extent of infestation if a pest problem arises, in this way, the local extension office can help topeoples. Prevent pest problems by cleaning house, yard and garden to remove places where pests can live and get food and water, and keep pests outdoors by blocking their way in. Determine whether chemicals are needed, and try to use nonchemical management methods, such as beneficial predators and parasites (like ladybugs, nematodes, predator mites, lace wings) or physical methods like hand weeding, mulching, setting traps or using a flyswatter. Choose a pesticide product, if needed, by looking for one that is specific for the pest a person have, and is also in the proper form (bait, spray, etc.). Buy only pesticides that are in their original containers with the label attached by s registered company. Discuss alternate locations with beekeepers (upwind, shelter belts, etc.) where possible to protect bees and other pollinators.

### 6.2. Dilution and Application of Pesticides

Every time follow directions on the label exactly and do not increase or reduce the use rate or use the product for purposes other than those on the label. Wear protective clothing as described on the label, and wearing of a long-sleeved shirt, long pants, non-absorbent gloves and shoes, goggles and a dust or mist filter mask helps to protect from exposure. Store protective clothing

away from living spaces and never smoke or eat while handling pesticides. Mix or dilute pesticides outdoors in a well-ventilated area and mix only the amount needed for the immediate job. Never use the same measuring cups and spoons used for pesticides to prepare food, even if washed. Always close child-resistant packaging correctly, even when only stopping for a break or between mixings. Use child-resistant insect or rodent baits and place them in areas where children and pets cannot reach to them. Keep children, pets and toys away from areas where pesticides are mixed and applied until the pesticide has dried or for as long as is stated on the label. Avoid broadcast or total release aerosol applications indoors when possible and do not let pesticides to contaminate food or food preparation surfaces. Ventilate thoroughly after any indoor application and clean up spills promptly according to label directions. Generally, liquid pesticides can be sprinkled with sawdust, kitty litter or vermiculite and swept into a plastic bag for proper disposal in an outdoor trash container. Wash exposed skin; rinse gloves, shoes or boots; change clothes after applying pesticides. Wash clothes soiled with pesticides separately from other laundry in hot water and detergent (Sarwar and Salman, 2015 d).

### 6.3. Storing and Discarding of Pesticides

Buy the least amount of pesticide practicable for the job to reduce storage and disposal problems, and follow storage directions on the label. Keep pesticides in their original containers with their original labeling and store pet-use and all other pesticides away from family medicines and toiletries. Keep pesticides, and any equipment used to apply them, in a locked cabinet in a well-ventilated area, away from children, pets and food. While discarding of pesticides, follow disposal directions on the label for getting rid of leftover pesticide and empty containers. Never pour pesticides down the sink, toilet, and sewer drain or onto the ground and at no time reuse a pesticide container.

### 6.4. Curtailing Environmental Impacts

Permanently, follow label directions to prevent pesticides from getting into groundwater or surface water. And do not apply pesticides right before a heavy rain or in places where they might wash into water bodies. Use pesticides when the wind is no more than a light breeze and the temperature is cool, such as early morning or evening, to reduce travel of pesticide to nearby areas. Pay attention to information on potential hazards to wildlife, fish, bees and endangered plants or animals listed in the environmental hazards section of the label (Sarwar and Salman, 2015 e).

### 6.5. Pesticide Poisonings

When a person is unconscious, having trouble in breathing or having convulsions, call to general practitioner or have someone else call to the local emergency service. In all other cases, call a physician for medical assistance, read the label for first aid instructions and give first aid. In addition to a physician, a poison control center or local emergency service can be helpful. Always have the pesticide label handy when calling for medical advice or visiting a consultant or health care provider, clinic or hospital.

## 7. Conclusion

Community needs more food to feed increased humans population and this is only possible through high yielding varieties of food grains like cereals or pulses, as will as other food materials like oilseeds, sugar, fruits and vegetables. All these plants need nutrition through roots from soil and these nutrients in large quantity can only be fortified to soil through use of chemicals, as organic manuring is just not possible. But limitations of many chemicals such as their excess or un-controlled use can spoil the soil properties, osmatic pressure, pH, conductivity and water holding capacity, and may also affect adversely on population of micro-organisms and other parameters. Insects are required in their last stage of life like bees, wasps and butterflies to carry out pollination of plants. But excess population of insects as larvae damages crop in large quantity. This affects the yield and quality of food grains for human beings, thus precise use of insecticides or pesticides controls the population of insects. Most pesticides of new generation are specific to action on specific insect pests and some are crop specific also. New generation of pesticides or insecticides is safe for humans as they do not metabolized in human body to produce toxic effects. On the other side of coin, disadvantages of insecticides lie in their excess or uncontrolled use resulting to spoil the balance of insect population to carry out pollination, can also travel in food chain to animal and human bodies, may accumulate to induce toxic effect in future or in coming generations, and may also affect adversely on population of micro-organisms and other helping parameters of agriculture and food chain. Pesticides have played a key role in providing reliable supplies of agricultural produce at prices affordable to consumers, improving the quality of produce, and ensuring high profits to farmers. Although pesticides are developed to function with reasonable certainty and minimal risk to human health and the environment, many studies have raised concerns about health risks from exposure of farmers and from end-users exposure to residues found on food and drinking water. For feeding of the world's population satisfactorily, crop protection methods and products will always be needed to reduce yield losses caused by pests. But maintainable choices should be made while applying pest control methods and products in order to lessen possible injury to food security, ecosystem services, and full functionality of all systems of the environment.

**References**

Akbar A, Sarwar M, Ahmad N, Tofique M. (2005). Evaluation of Different Granular Insecticides for the Suppression of Rice Stem Borers. Proce. 25th Pakistan Conger. of Zoology, March 1-3, Sindh Agriculture University, Tandojam. 25: 49-55.

Barbosa WF, Smagghe G, Guedes RNC. (2015). Pesticides and reduced-risk insecticides, native bees and pantropical stingless bees: Pitfalls and perspectives. Pest Management Science, 71 (8): 1049-1053.

Berny P. 2007. Pesticides and the intoxication of wild animals. J. Vet. Pharmacol. Ther., 30: 93-100.

Chagnon M, Kreutzweiser D, Mitchell EAD, Morrissey CA, Noome DA, Van der Sluijs JP. (2015). Risks of large-scale use of systemic insecticides to ecosystem functioning and services. Environ. Sci. Pollut. Res., 22: 119-134.

Cooper J, Dobson H. (2007).The benefits of pesticides to mankind and the environment. Crop Prot., 26: 1337-1348.

Damalas CA. (2009). Understanding benefits and risks of pesticide use. Sci. Res. Essays, 4: 945-949.

Kearns CA, Inouye DW. (1997). Pollinators, flowering plants, and conservation biology. Bioscience, 47: 297-307.

Kohler HR, Triebskorn R. (2013). Wildlife ecotoxicology of pesticides: Can we track effects to the population level and beyond? Science, 341: 759-765.

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

Mughal AR, Sarwar MH, Sarwar M. (2015). Exploring the Causes, Diagnosis, Symptoms, Risk Factors, Treatments and Prevention of Rheumatic Fever. Journal of Pharmacy and Pharmaceutical Sciences, 3 (1): 1-8.

Oerke EC; Dehne HW. (2004). Safeguarding production-losses in major crops and the role of crop protection. Crop Prot., 23: 275-285.

Sarwar, M. (2013). Comparative Suitability of Soil and Foliar Applied Insecticides against the Aphid *Myzus persicae* (Sulzer) (Aphididae: Hemiptera) In Canola *Brassica napus* L. International Journal of Scientific Research in Environmental Sciences, 1 (7): 138-143.

Sarwar M. (2014). Defeating Malaria with Preventative Treatment of Disease and Deterrent Measures against Anopheline Vectors (Diptera: Culicidae). Journal of Pharmacology and Toxicological Studies, 2 (4): 1-6.

Sarwar M. (2015 a). The Killer Chemicals as Controller of Agriculture Insect Pests: The Conventional Insecticides. International Journal of Chemical and Biomolecular Science, 1 (3): 141-147.

Sarwar M. (2015 b). The Killer Chemicals for Control of Agriculture Insect Pests: The Botanical Insecticides. International Journal of Chemical and Biomolecular Science, 1 (3): 123-128.

Sarwar M. (2015 c). The Dangers of Pesticides Associated with Public Health and Preventing of the Risks. International Journal of Bioinformatics and Biomedical Engineering, 1 (2): 130-136.

Sarwar M. (2015 d). Commonly Available Commercial Insecticide Formulations and Their Applications in the Field. International Journal of Materials Chemistry and Physics, 1 (2): 116-123.

Sarwar M. (2015 e). Insect Borne Diseases Transmitted by Some Important Vectors of Class Insecta Hurtling Public Health. International Journal of Bioinformatics and Biomedical Engineering, 1 (3): 311-317.

Sarwar M. (2015 f). Skin Disorders Inflicted Through Insect Invertebrates Along with Diagnosis and Treating of Cases. Journal of Nanoscience and Nanoengineering, 1 (4): 233-240.

Sarwar M. (2015 g). Insect Vectors Involving in Mechanical Transmission of Human Pathogens for Serious Diseases. International Journal of Bioinformatics and Biomedical Engineering, 1 (3): 300-306.

Sarwar M. (2015 h). Usage of Biorational Pesticides with Novel Modes of Action, Mechanism and Application in Crop Protection. International Journal of Materials Chemistry and Physics, 1 (2): 156-162.

Sarwar M. (2015 i). Microbial Insecticides- An Ecofriendly Effective Line of Attack for Insect Pests Management. International Journal of Engineering and Advanced Research Technology, 1 (2): 4-9. 49).

Sarwar M. (2015 j). Biopesticides: An Effective and Environmental Friendly Insect-Pests Inhibitor Line of Action. International Journal of Engineering and Advanced Research Technology, 1 (2): 10-15.

Sarwar M, Salman M. (2015 a). Insecticides Resistance in Insect Pests or Vectors and Development of Novel Strategies to Combat Its Evolution. International Journal of Bioinformatics and Biomedical Engineering, 1 (3): 344-351.

Sarwar M, Salman M. (2015 b). Toxicity of Oils Formulation as a New Useful Tool in Crop Protection for Insect Pests Control. International Journal of Chemical and Biomolecular Science, 1 (4): 297-302.

Sarwar M, Salman M. (2015 c). Success Stories of Eco-friendly Organically Acceptable Insecticides as Natural Products Discovery. International Journal of Materials Chemistry and Physics, 1 (3): 392-398.

Sarwar M, Salman M. (2015 d). The Paramount Benefits of Using Insecticides and Their Worldwide Importance in Food Production. International Journal of Bioinformatics and Biomedical Engineering, 1 (3): 359-365.

Sarwar M, Salman M. (2015 e). Overall Notable Health Challenges About the Toxicity of Pesticides Concerning to End Users. International Journal of Bioinformatics and Biomedical Engineering, 1 (3): 323-330.

Sarwar M, Akbar A, Ahmad N, Khan G Z, Bux M, Tofique M. (2007). Field Performance of Systemic Foliar and Granular Insecticides against Rice Stem Borers (*Scirpophaga* spp.) in Rice Crop. Proce. 26th Pakistan Conger. of Zoology, Multan, March 1-3. 27: 89-94.

Sarwar MF, Sarwar MH, Sarwar M. (2015). Understanding Some of the Best Practices for Discipline of Health Education to the Public on the Sphere. International Journal of Innovation and Research in Educational Sciences, 2 (1): 1-4.

Sarwar MH, Sarwar MF, Sarwar M. (2014). Understanding the Significance of Medical Education for Health Care of Community around the Globe. International Journal of Innovation and Research in Educational Sciences, 1 (2): 149-152.

Soares WL, Porto MFD. (2009). Estimating the social cost of pesticide use: An assessment from acute poisoning in Brazil. Ecol. Econ., 68: 2721-2728.

Wilson C, Tisdell C. (2001). Why farmers continue to use pesticides despite environmental, health and sustainability costs. Ecol. Econ., 39: 449-462.