Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2019; 7(5): 1376-1379

Received: 04-07-2019
Accepted: 06-08-2019

Nidhi K
Assistant Manager - R&D (Agri.) at Parijat Industries India Pvt. Ltd., New Delhi, India

Upendra K
Assistant Manager - EHS at Mahindra & Mahindra Limited, Nagpur, Maharashtra, India

Corresponding Author:
Nidhi K
Assistant Manager - R&D (Agri.) at Parijat Industries India Pvt. Ltd., New Delhi, India

Safe approach towards pesticide usage

Nidhi K and Upendra K

Abstract
It is a fact that with the increasing population, the food security and sustainable agriculture have become of prime importance. The agricultural production needs not just to be marked up but also to be stabilized over a period to meet the future needs. The role of Agrochemicals in this context cannot be neglected. Crop protection plays a key role in attaining the sustainability and agrochemicals are the indispensable part of achieving this crop protection. However, safety is one such aspect, which is widely neglected while using the agrochemicals, due to which its hazards are multiplied manifold. The major issue is whether we are ready to accept the risks associated with the chemicals in the pursuit of a food sustainable world and mitigate them. Mostly this outcry is because the effort to understand the chemistry has never been done. The blame game can continue for an eternity but that won't fetch us the required resources or an ideal world with food security. Understanding the chemistry, toxicity and its hazards and then managing it in the best and the safest way possible is the need of the hour.

Keywords: Pesticides, Safety, Sustainability

Introduction
Pesticides are chemicals that are often used for pest control in Agriculture. These agrochemicals are majorly deployed to control the pests and to attain high yield and production levels. In today's world food security is a very big question, the world population is increasing exponentially. Currently the world population is 7.7 billion, however the united nation projects the world population to reach 10 billion mark by 2057. Thus, in such a situation the food security and sustainable agriculture are extremely important [1]. Inception of the green revolution in India, made the farmers aware of how the genetic potential of crop coupled with pest control measures could help protect the crop and lead to greater yields [2]. However, the Indian farming community did not just accept the revolutionary changes, but somewhere because of certain reasons this use shortly changed to Misuse. The perceptions thus changed, and safety became of prime focus while using Agrochemicals. The current pesticide use scenario Is quite different in India as compared to the other countries. The Agrochemicals in India are regulated by the Government and extensive technical data and other complex information is required before the registration of any chemical [3]. All chemicals come with their specific recommendations and application do's and don'ts. However, these things are not given much importance at the farmer level. Thus, what the farmers practice is the highly unsafe methods. The pressure to produce more is to such an extent that the number of applications, the doses used, and the combination partners selected always bypass the safety norms and actual recommendation standards set by the regulatory authorities. Even if India, being a developing nation, adopts the Integrated pest management programme to combat the ill effects of unregulated agrochemical hazards, we still need to understand that chemical control is an important and integral aspect of the Integrated programme as well [4]. The agrochemicals are important measures to ensure food security, however the only thing we need to be concerned about is, their judicious and optimum use within the set standards. Going by the facts and figures, China is the largest consumer of Pesticides, consuming on an Average of 1806 Million Kg Annually, China is followed by USA with an annual consumption of 386 Million Kg. India stands only 10th in the world pesticide consumption, with annual consumption of only 40 Million Kg [5]. Thus, it's not all about the agrochemicals but also about its usage and application methods that can provide better precision and efficacy. Partly from focusing on WHY, we also need to figure out HOW to use them hazard free.

Pesticide Toxicity: When dealing with pesticides**,** it becomes very important to characterize the risk associated with agrochemicals, to identify the routes of exposure and finally to minimize the chemical exposure. As per the revised toxicity classification of pesticides, issued by Central Insecticide board, GOI the Pesticides are now classified into 5 categories.

1. **Bright Red**: This category is extremely toxic with a symbol of Skull & cross bones and the Signal word 'Fatal poison' both printed in red colour.
2. **Orange:** This category is highly toxic with the symbol of Skull & cross bones printed in red color and the word poison printed in red colour.
3. **Bright Yellow:** This category is moderately toxic with the signal word POISON' printed in red
4. **Bright Blue:** This category is slightly toxic with the signal word Danger
5. **Bright Green:** This category is unlikely harmful with the signal word caution

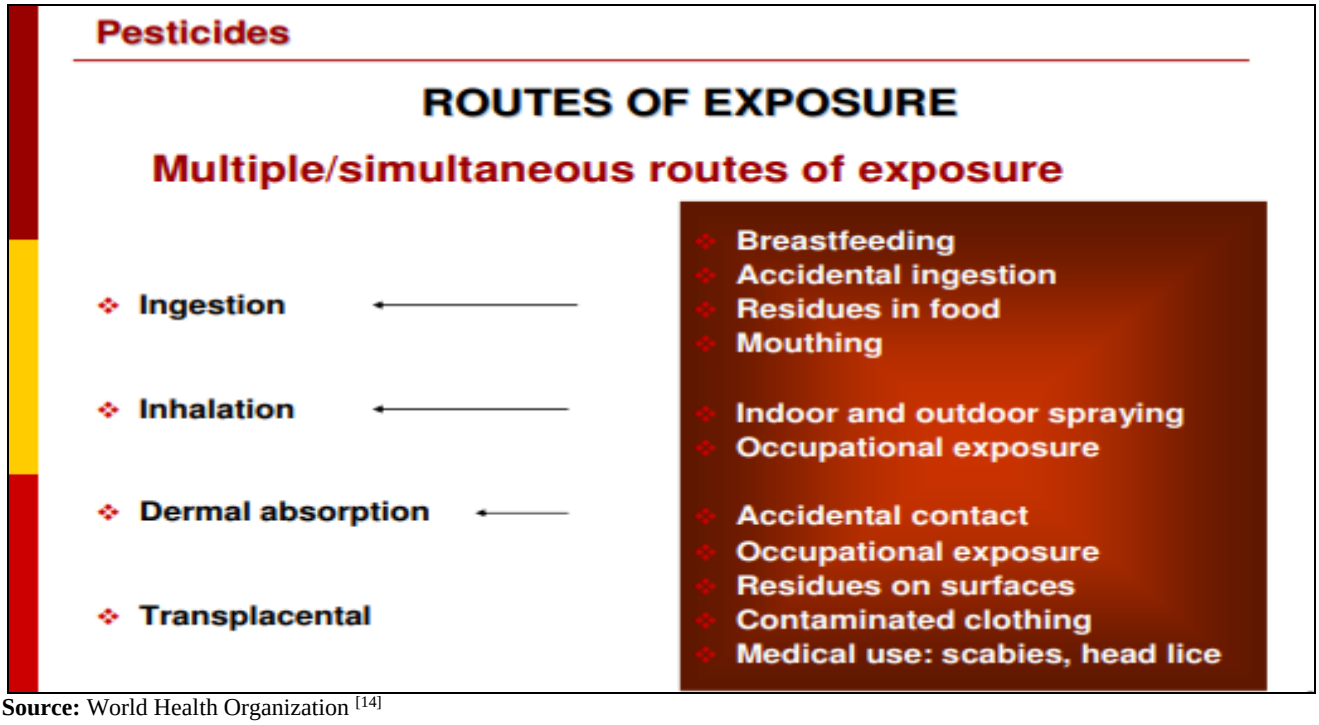
The bright red category is the most hazardous and is now phasing out as everyone is now looking forward for green chemistries. The toxicity of a molecule is assessed in the toxicology laboratories and is depicted in terms of LD_{50} and LC_{50} values. Viz the lethal doses and lethal concentrations. These are basically the values that are potent enough to kill 50% of a population when exposed to it. The risk associated with any chemical is dependent on its toxicity and its exposure. And based on it the toxicity can be acute, sub chronic or chronic [7].

Routes of Exposure and the use of PPE

The farming fraternity is the one which is always at a higher risk of exposure as compared to the other end users of agricultural produce. The farmers always come into direct as well as indirect contact with the agrochemicals. There is always a risk of drift or getting into contact with a chemical residue on the crop. Apart from such indirect risks, farmers often come into direct contact with the chemicals such as during making spray solution, cleaning spray equipment, spraying etc. Improper handling may result in severe poisoning, and other chronic health hazards [6].

The chemicals basically have four major routes of exposure [8].

1. **Inhalation:** It is one of the most common ways in which chemicals can enter the body. Dust, Mist, Fumes and vapors can be inhaled through the nose or mouth and travel into the lungs where they can begin to cause damage.
2. **Ingestion:** Some hazardous chemicals can easily be absorbed through the digestive system; thus, it is always advised not to eat, smoke or drink while applying or handling pesticides. It is also possible to swallow chemicals if food is left uncovered where there is a risk of exposure to the chemicals.
3. **Absorption:** Some hazardous chemicals can enter the body by passing through skin or eyes. Abrasions and Punctures in the skin surface will increase the rate at which the chemical is absorbed in the body.
4. **Injection:** Chemicals can also enter the body through blood stream, through lacerations, punctures or syringe needles.



Source: World Health Organization [14]

Routes of Exposure

Pesticides enter the body through three main routes: dermal/ocular (skin/eyes), respiratory/inhalation (breathing), and ingestion (swallowing). PPE/ Personal protective Equipment are designed to protect the routes of pesticide exposure to humans from a wide variety of pesticide types and toxicities.

1. **Body cover:** Regular cotton clothing, full Pants and shirts are acceptable for Slightly toxic and Unlikely harmful category of pesticides. However, when dealing with Moderately toxic to Danger / Poison category on should be adequately equipped with chemical proof dry protective suits that fully cover the body from Top to bottom. Such cover all's are one- or two-piece garments that are worn over the regular work attire. The suits may

be disposable or reusable. Various versions of it are available such as, woven, non-woven, coated, laminated etc. The choice of the body cover depends on the nature of the hazard and toxicity of the chemical being dealt with [9].

2. **Boots:** Ankle length boots that are chemical resistant should be worn when handling moderately or highly toxic pesticides.
3. **Gloves:** Elbow length gloves that are chemical resistant should be worn while handling the chemicals. The gloves are available in various materials ranging from Natural rubber, Nitrile, Neoprine, Polyethylene etc. leather or cotton gloves should not be used as they absorb the chemicals and can cause contamination [10].
4. **Goggles or Face shield:** shielded safety glasses; a full-face respirator; snug-fitting, non-fogging goggles; or a full-face shield should be worn whenever there is a possibility of the chemical contacting the eyes. Safety glasses with brow and side shields are acceptable for low exposure situations. Goggle with a full-face respirator should be worn when working in a highly toxic spray or dust.
5. **Head and Neck covering:** It is most critical to safeguard the head and neck in stations where risk of being exposed from overhead dusts or sprays is possible, such as hand-spraying uphill or when flagging for aerial applications. Chemical-resistant rain hats, wide brimmed hats, and washable hard hats (with no absorbing liner) should be used [11].

Safe Application

The right application of agrochemical is as important as is its right selection. More than 98% of the pesticides applied reach a destination other than their target [14]. Thus, the precision application is of great importance. Safety during application is of utmost importance, as the consequences it manifests are immense. Our ecosystems hold complex mechanisms that function for the homeostasis. As it is a well-established theory that matter can neither be created nor destroyed, it only changes its form from, one form to the other, thus anything added to our environment is taken up and the biological systems involved try to degrade it. The complexities of the matter added to the environment determines the form that they will be broken down to. Indiscriminate and injudicious addition of chemicals in the ecosystem often lead to its bioaccumulation and causes phenomenon like eutrophication, [12] that ultimately impact the balance and the condition of homeostasis. Our environment and ecosystems like to be in a state of balance and when this balance is disturbed, it leads to a series of grievous complications adding on to the hazards and threat to safety of the environment, the earth as well as its inhabitants. Safe application of Pesticides includes the following:

1. **Proper identification of the pest/ weed, and the right choice of pesticide for the control of the pest:** The right control measure can only be adopted once the diagnosis is right. The choice of the wrong pesticide can jeopardize both the crop and subsequently the human health, as the end produce is directly consumed by the humans as food. Certain molecules are crop or stage specific and thus if applied on the wrong crop or at the wrong stage can cause a lot of hazards [13].
2. **Right calibration of doses:** All molecules come with a set of recommendations, which if not adhered to may can cause a breach of safe pesticide handling practices. The doses though may appear to be just a number, but these are calibrated after a lot of research and trials. The doses are set not just on the efficacy parameters but also on the Maximum residue levels (MRL) values. MRL is the highest level of a pesticide residue that is legally tolerated in or on food or feed when pesticides are applied correctly [15]. Thus, if food contains pesticides above this threshold limit, it can pose a serious threat to the human health.
3. **Right time of application:** The time of application plays a very important role in determining the safety. It is usually advised that the applications should be done either in the morning or the evening when the sun intensity is low, applications done in the scorching sun may lead to the disintegration of the chemicals and the byproducts thus formed can prove to be poisonous to the sprayer and thus have the potential to deeply impact his health. Also, care should be taken to avoid the foraging period of the honeybees, as most chemical kill the bees, and these are the natural pollinators. Sprays should not be done during high wind velocities, as they pose the chances of drift. Even during normal days, the spray application should never be done against the direction of the wind as in this case the spray solution will fall on the person who is spraying and cause contamination.
4. **Handling as per label:** The pesticide label contains the important information regarding the handling and the usage of the chemical. It contains all the information regarding the toxicity category of the product, in the form of the color-coded triangle. It is very important to read all the instructions very carefully and to abide with them.
5. **Safety measures to be adopted after Application:** Safe usage does not end at just the application part. Post application care is equally important. It is a general tendency to wind up the task as soon as possible. But when dealing with pesticides the winding up part also requires certain standard operating procedures. Once the spray part is complete the empty containers and pouches should all be collected and disposed of, in a safe manner, they should never be thrown out in the field. The spray should be thoroughly washed with soap and water, as this would prevent any kind of contamination when using the sprayer in future [16]. Thereafter all the disposable PPE's should be carefully disposed away in a safe manner. The person involved in spraying should always take a thorough bath after the task is completed. And the clothes worn during the period should also be washed thoroughly. It is advised to keep a separate set of clothes for this purpose. Even with the utmost care and use of PPE's there are chances that the individual would carry some load of the chemical, however this load is reduced to a great extent when PPE's are worn, and safety standards are followed.
6. **Safety during contamination and First aid:** It so happens that when sometimes the safety norms are by passed or, or sometimes even while following all the safety standards, contaminations can take place. If any individual has come into close contact with a pesticide, he should be immediately taken to the nearest emergency center or else, it could even lead to lethal consequences. The container/Information of the pesticide involved in poisoning /Contamination should also be carried with the patient, as sometimes it helps the Doctors to prescribe the

right antidote timely [18]. Usually antidotes like diazepam, Atropine, activated charcoal etc. are administered to the patient according to the poisoning.

7. **Adhering with the pre harvest intervals:** Pre harvest interval is the interval after pesticide application till the time when the produce from the sprayed filed should not be harvested or consumed. Harvesting before the set standard time causes the plants to have more than the admissible limits of the pesticide load. Which can enter the human body and cause serious health risks. After the application depending on the activity the pesticide is taken up by the plant system, the chemical then goes through natural processes, and gets degraded or metabolized by the plant system into multiple by products that are relatively less lethal [17]. Harvesting the plant before the pre harvest interval, does not allow the plant to metabolize or degrade the chemical, leading to produce laden with heavy pesticide load or residue that imposes a serious health hazard and can lead to various complications and diseases. Even from the business export point of view it is not good as many countries follow strict rules and allow only the produce with permissible pesticide limits or MRL's. Taking care of all such things will ensure safety. The farmers and the users should be well sensitized towards this issue so that they know how to keep themselves safe and what to do in an event of a mishap. They should be aware about the storage conditions of the pesticides, they should check for any kind of leakages and should make it a point to take care of all the firefighting measures in an event of a fire, All such chemicals should be kept away from the reach of children [20].

   Agrochemicals have mostly been portrayed as hazardous, which they are but only when they are miss handled or misused. When used correctly they bring along a lot of benefits with them such as reduction in drudgery, pest control, food security etc. [19]

Conclusion

Food security has always been of high concern for any developing nation, and agrochemicals are the tools that help us achieve that goal. The above article throws light on the safety aspect linked with the agrochemicals and how its correct use is equally important in order to attain sustainability. The integrated approach too relies on the amalgamation of the various pest control techniques, which includes the chemical use also. Thus, it is of utmost importance that the correct usage methodology should be communicated to the farmers and efforts should be made to sensitize them for the proper use, so that the hazards associated with the health and environment may be mitigated. The pros and cons are always associated with any technology, however the correct segment along with the right method of use helps it develop into success. Safety in agrochemicals have always been neglected but focusing on it will help mitigate the hazards and help us emerge as a leader in another Green revolution.

References

1. Oerke EC, Dehne HW. Safeguarding production-losses in major crops and the role of crop protection. Crop Protection. 2004; 23:275-285.
2. Anand G. Green revolution in India wilts as subsidies backfire. Wall Street Journal, 2011.
3. Christos A Damalas. Understanding benefits and risks of pesticide use. Scientific Research and Essay. 2009; 4:(10):945-949,
4. Dhawan AK. Cotton pest scenario in India and its control. In: Proceedings of the 3rd Asia Pacific Crop Protection Conference, 6–7 September 2001, New Delhi, India, 2001, 115-127.
5. https://www.worldatlas.com/articles/top-pesticide-consuming-countries-of-the-world.html
6. Woodruff TJ, Kyle AD, Bois FY. Evaluating health risks from occupational exposure to pesticides and the regulatory response. Environmental Health Perspectives. 1994; 102:1088-1096.
7. Nesheim ON, Fishel FM, Mossler M. Toxicity of Pesticides. PI-13; University of Florida (UF), Institute of Food and Agricultural Sciences (IFAS) Extension: Gainesville, FL, USA, 2014, 6.
8. Maroni M, Fait A, Colosio C. Risk assessment and management of occupational exposure to pesticides. Toxicology letters. 1999; 107:145-153.
9. Coffman CW, Stone J, Slocum AC, Landers AJ, Schwab CV, Olsen LG *et al*. Use of engineering controls and personal protective equipment by certified pesticide applicators. Journal of Agriculture safety and Health. 2009; 15:311-326.
10. Branson DH, Abusamra L, Hoener C, Rice S. Effect of glove liners on sweat rate, comfort, and psychomotor task performance. Textile Research Journal. 1988; 58(3):166-173.
11. Easter EP, Nigg HN. Pesticide protective clothing. In Reviews of Environmental Contamination and Toxicology New York, N.Y.: Springer. 1992; 129:1-16.
12. Khan A, Ansari A. Eutrophication: An Ecological Vision. The Botanical Review. 71(4):449-482
13. Toshiyaki, Surfactant effects on environmental behviour of pesticides, Review of environmental contamination and toxicology, Springer Edts. 2008.
14. https://www.who.int/ceh/capacity/Pesticides.pdf
15. EFSA. 2008 Annual report on pesticide residues according to article 32 of regulation (EC) No 396/2005. EFSA Journal. 2010; 8(6):1646
16. Ogg CL, Schulze LD. Managing the risk of pesticide poisoning and understanding the signs and symptoms, University of Nebraska-Lincoln Extension, Extension Circular EC2505, 2006. A
17. Holland J, Sinclair P. Environmental fate of pesticides and the consequences for residues in food and drinking water, in: Pesticide Residues in Food and Drinking Water: Human Exposure and Risks, Hamilton D. & Crossley S. (Ed.), 27 – 62, John Willey &Sons LTD, 0-West Sussex, England, 2004; 91(3):471-489
18. Jaga K, Dharmani C. Sources of exposure to and public health implications of organophosphate pesticides, Rev. Panam, Salud Publication. 2003; 14(3):171-85,
19. Cooper J, Dobson H. The benefits of pesticides to mankind and the environment. Crop Protection. 2007; 26:1337-1348
20. Colborn T, Myers JP, Dumanoski D. Our stolen future: how we are threatening our fertility, intelligence, and survival: a scientific detective story, New York: Dutton, 1996.