

## **“A review on over usage of Pesticides in agriculture, their impact on health and environment in India and Determination of nitrogen containing pesticides present in various fruits and vegetables”**

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### **Abstract**

Food is essential for the survival of life. There is a tremendous increase the population in India. To meet the basic needs of people there is an urge need of increase in the production of food materials which must be healthy and hygienic. There is an evidence of widespread usage of harmful pesticides in agriculture, though they are used to control the pests, but they unknowingly polluting the water, soil and entering in to the food chain. Pesticide residues directly entering in to human beings affecting the health disorders. In this work we collected the secondary data from various sources and also did some experiments in the chemistry lab and determined the presence nitrogen containing pesticides present in various fruits and vegetables. This work is taken up to aware the people how much the threat is for Human and Environment.

**Keywords:** Pesticides, Agriculture, Pollution, Environment, Ground Water and Soil.

### **1. Introduction**

In the decade, there has been a tremendous increase in the guilds of various crops to meet the demand of our growing world population. This great feat has been achieved by adopting new methods of forming and by expensive use of fertilizers and insecticides. Globally more than half of the pesticides are utilized in Asia. India stands 12<sup>th</sup> in pesticide use globally and 3<sup>rd</sup> in Asia after China and Turkey.

Human started growing plants almost 10000 BC in the fields for food and he moved from living in trees to open land. However, the demand for food increased, to meet the demand for more food, the farmer started using fertilizers and protecting the crops from pathogens. Plant pathogens are called as pests. Plant diseases caused by pests became a big problem, pests entry in to the crops field is to be restricted, otherwise wipe off the entire crop. Human have utilised pesticides to protect their crops. Pesticides are substances (natural or manmade) used to control pests, weeds, and diseases in plants in various agronomic practices. Herbicides, insecticides, fungicides, rodenticides, nematocides, and other pesticides are examples of pesticides. The losses of crops caused by insect pests are quite high in both developing and developed countries

Pests include insects, Plant pathogen insects, Molluscs, Birds, Mammals, Fish nematodes and microbes Ex:-DDT, BHC, Zinc Phosphide, Mercuric Chloride, Dinitro Phenol etc...

## 2. Literature Review

Since before 20BC, humans have utilized pesticides to protect their crops. The first known pesticide was elemental sulphur dusting used in ancient summer about 4500 years ago in ancient Mesopotamia. By the 15th century, toxic chemicals such as arsenic, mercury and lead being applied sulphate was extracted from tobacco leaves for use as an insecticide. The 19th century saw the introduction of two more natural pesticides, pyrethrum, which is derived from chrysanthemums, rotenone which is derived from the roots of tropical vegetables.

In 1940s manufacturers began to produce large amounts of synthetic pesticides and their use became wide spread. Some sources consider the 1940s and 1950s to have been the start of the “Pesticide era” Pesticide use has increased 50 fold since 1950 and 2.3 million tonnes of pesticides are now used each year.

In 1960s it was discovered that DDT was preventing many fish eating birds from reproducing, which was a serious threat to biodiversity. The agricultural use of DDT is now banned under the stock hold convention, but it is still used in some developing nations. A closer look at pesticide use finds that we're using more pesticides and treating crops more frequently than ever before. Global pesticide use (in tonnes of active ingredient) increased by 46% between 1996 and 2016, according to the FAOSTAT database ([WHO, 2019](#)). Pesticides work by causing harm to the creatures they target. However, pesticides do not function in the same way for every species. They also have an impact on non-target species. Organophosphate, carbamate, and pyrethroid insecticides are the most often used pesticides ([Gilbert, 2012](#)). Currently, around four million tonnes are used per year on a global basis, most of which are herbicides (56%), followed by insecticides (19%), fungicides (25%) and other types such as rodenticides and nematicides ([FAO, 2018](#)).

## 3. Significance

As pesticides are hazardous and toxic to human health, any pesticide residue remaining in fruits and vegetables can pose danger to humans and cause certain disease. It is important to identify and quantify the pesticides which can be injected by fruits and vegetables after pesticide spray

Pesticides are very hazardous and lethal for organisms as well as for humans. Pesticides also toxic to plants and many food crops, including fruits and vegetables contains pesticide residues after being washed or peeled.

A number of pesticides are highly toxic and even in very small quantities these pesticides can result in the death of humans and animals. Long term health problems such as respiratory, memory disorders, dermatological conditions, cancer etc have been known to be associated with pesticide exposure. The major source of pesticide exposure in children and infants is through diet.

The most common path way for pesticide to enter the body is orally, through mouth and the digestive system. Oral exposure may occur as a result of negligence, eating without proper hygiene after using pesticides.

## 4 Methodology

The data is collected from various database and journals through internet and a chemical test is done to determine the nitrogen containing pesticides present in various fruits and vegetables in our chemistry laboratory.

### Pesticides usage and their impact on health and environment in India

Pesticide usage in India is widespread, as agriculture is a significant part of the country's economy. Pesticides are used to protect crops from pests, diseases, and weeds, but their extensive use has raised concerns about their impact on human health and the environment. Pesticides harm and accumulate in more other places than crops due to poor management/mishandling, or a lack of information (misuse and overuse).

### Classification of pesticides

#### 1. Classification of pesticides according to its toxicity:

Pesticide toxicity is primarily determined by two factors: dose and time. Thus, the amount of this chemical (dose) is involved and how often (time) the material is exposed to lead to two different kinds of toxicity, acute and chronic.

**Table 1: Pesticides classification on the basis of its toxicity**

WHO Class	LD <sub>50</sub> for rats (mg/kg of body weight)	
	Oral	Dermal
Class- I <sub>a</sub> Extremely Hazardous	Less than 5	Less than 5
Class-I <sub>b</sub> Highly Hazardous	5 to 50	5 to 200
Class-II Moderately Hazardous	50 to 2000	200 to 2000
Class-III Slightly Hazardous	Over 2000	Over 2000
Class-V Unlikely to present acute hazard	5000 or higher	

#### 2. Classification of Pesticides according to Chemical Composition :

This is the most popular and useful way of pesticide classification based on chemical makeup. Pesticides such as insecticides, fungicides, herbicides, and rodenticides are also classed based on their chemical compositions, as shown below:

a. Insecticides: Insecticides are classed chemically as Carbamates (Carbaryl), Organochlorine (Endosulfan), Organophosphorus (Monocrotophos), Pyrethroids

(permethrin), Neonicotinoids (Imidacloprid), various pesticides such as Spinosyns (Spinosad), Benzolureas (diflubenzuron), Antibiotics (abamectin),

b.Fungicides: Fungicides are categorised as aliphatic nitrogen fungicides (dodine), amide fungicides (carpropamid), aromatic fungicides (chlorothalonil), dicarboximide fungicides (famoxadone), dinitrophenol fungicides (dinocap), and others.

c.Herbicides: Herbicides include anilide herbicides (flufenacet), phenoxyacetic herbicides (2, 4-D), quaternary ammonium herbicides (Paraquat), chlorotriazine herbicides (atrazine), sulfonylurea herbicides (chlorimuron), and others.

d.Rodenticides: Rodenticides are classed as inorganic rodenticides (Zinc phosphide, Aluminium Phosphide) or organic coumarin rodenticides (bromadiolone, coumatetralyl)

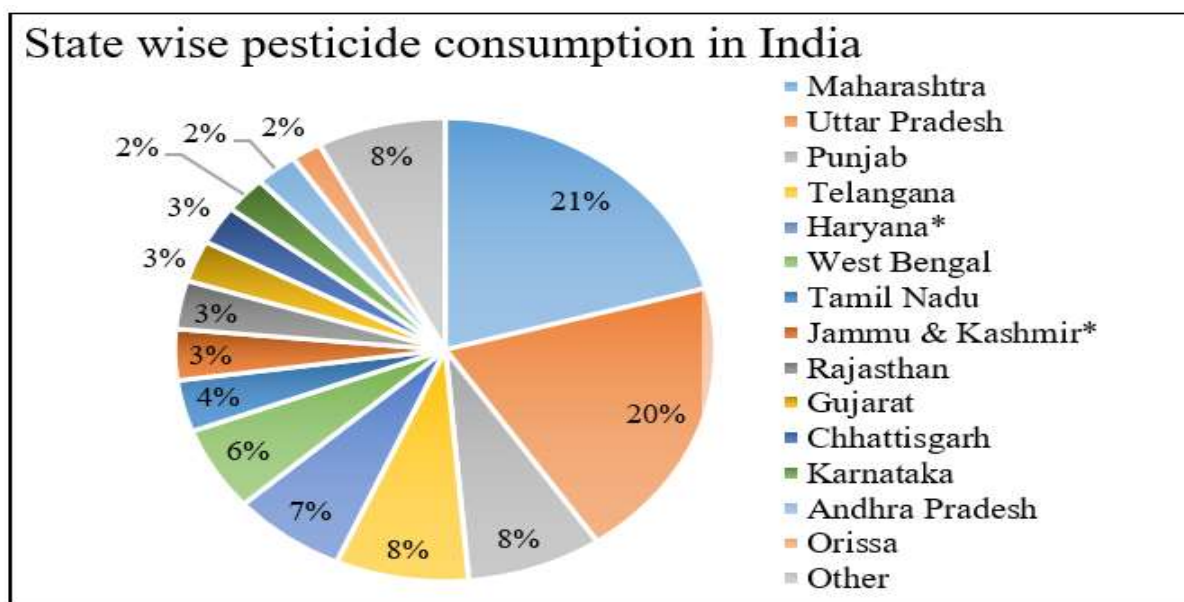


Figure 1: State wise pesticide consumption in India (2019-2020) (Source: (GOI, 2020))

Here are some key points regarding pesticide usage and its impact on health and environment in India:

1. **High Pesticide Consumption:**

- India is one of the largest consumers of pesticides globally. The agriculture sector relies heavily on pesticides to maximize crop yields and protect against pests and diseases.

2. **Health Impact:**

- Pesticides are chemicals designed to kill or control pests, but they can also have adverse effects on human health. Exposure to pesticides has been linked to various health issues, including respiratory problems, skin diseases, reproductive issues, and certain types of cancers.

Pesticides' role in cancer

Several epidemiological and molecular research highlighted a close association between persistent pesticides exposure and increased risk of diseases such as neurodegenerative disorders, endocrine disruptors, respiratory complications, reproductive disorders, and birth defects (García et al., 2017; Larsen et al., 2017; Addissie et al., 2020; Bast et al., 2021; Bhadauriya et al., 2021; Witczak et al., 2021; Gea et al., 2022; Iteire et al., 2022). In addition, the carcinogenic, teratogenic, and mutagenic nature of these compounds are also believed to be a contributing source of cancer development in the human population.

It has been observed that a person with a direct exposure to pesticides is highly susceptible to several human malignancies such as cancer including head, neck, breast, thyroid, brain, colorectal, pancreatic, lung, leukemia, prostate, non-Hodgkin lymphoma and ovarian cancer (Obiri et al., 2013; Pardo et al., 2020; Leonel et al., 2021; Lerro et al., 2021).

### 3. Occupational Exposure:

- Farmers and agricultural workers are at a higher risk of pesticide exposure due to their close proximity to the chemicals during application. Lack of proper protective gear and awareness exacerbates the risks.

### 4. Contamination of Water and Soil:

- Improper pesticide use can lead to the contamination of water sources and soil. Runoff from fields can carry pesticides into nearby water bodies, affecting aquatic ecosystems and potentially contaminating drinking water.

### 5. Residue in Food:

- Pesticide residues can persist on fruits, vegetables, and other crops even after harvesting. If not properly washed or treated, these residues may enter the food chain, posing a risk to consumers.

### 6. Regulatory Challenges:

- Despite regulations in place, the enforcement of pesticide standards in India faces challenges. Limited resources, lack of awareness among farmers, and the availability of cheaper but potentially harmful pesticides contribute to the problem.

### 7. Shift Towards Organic Farming:

- There is a growing awareness of the negative impacts of conventional pesticide use, leading to an increased interest in organic farming practices. Organic farming aims to minimize the use of synthetic chemicals, promoting healthier and more sustainable agricultural practices.

### 8. Government Initiatives:

- The Indian government has taken steps to regulate pesticide use and improve safety standards. However, effective implementation and enforcement at the ground level remain areas that need attention.

### 9. Public Awareness and Education:

- Promoting awareness among farmers and the general public about the proper use of pesticides, safety measures, and alternatives such as integrated pest management (IPM) is crucial for minimizing health risks.

### 10. Research and Innovation:

- Continued research into alternative pest control methods, development of safer pesticides, and the promotion of sustainable farming practices can contribute to reducing the negative impact of pesticides on health and the environment.

In summary, while pesticides play a crucial role in ensuring food security, their excessive and improper use poses significant health and environmental challenges in India. Balancing

the need for agricultural productivity with the protection of human health and the environment requires a multi-faceted approach involving regulation, education, and sustainable farming practices.

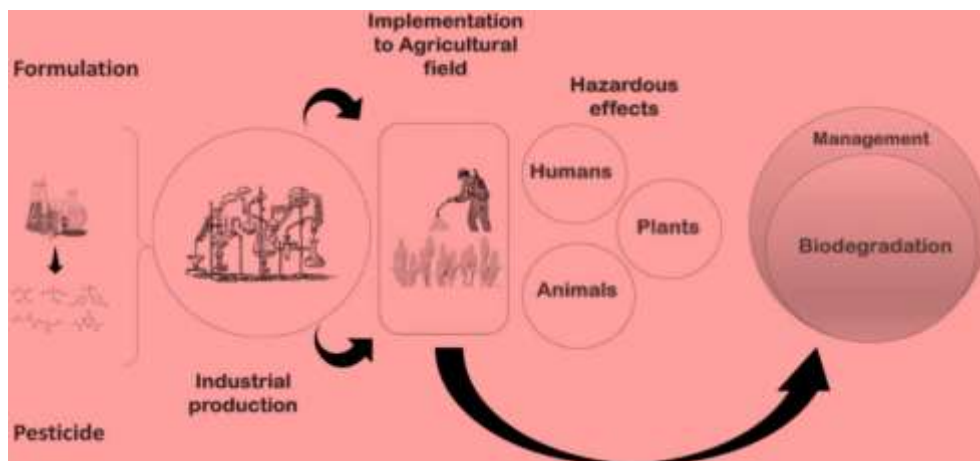


Figure2: Thematic diagram of the synthesis, production, uses, effects, and eco-friendly management of pesticides.

Name	Structure	Name	Structure
DDT (Dichlorodiphenyltrichloroethane)		Lindane	
DDD (Dichlorodiphenyldichloroethane)		HCH	
DDE (Dichlorodiphenyldichloroethylene)		Chlordecone	
Dieldrin		Toxaphene	
Aldrin		Mirex	
Endrin		Endosulfan	
Heptachlor		Chlordane	

Table 2. Generally used pesticides and their chemical structures.

## Determination of nitrogen containing pesticides present in various fruits and vegetables

### **i. Aim:**

To Study the presence of insecticides or pesticides (Nitrogen Containing) in various fruits and vegetables.

### **ii. Material Required:**

Mortar and pestle, beakers, funnel, glass rod, filter paper, china dish, water bath, tripod stand, fusion-tubes, knife, test-tube.

Samples of fruits, vegetables, alcohol, sodium metal, ferric chloride solution, ferrous sulphate crystals, distilled water and dilute sulphuric acid.

(We have purchased vegetables like radish, carrot, spinach, brinjal, potato, tomato, cauliflower, etc from the local market of Jagitial district head quarter)

### **iii. Procedure:**

1. Take different kinds of fruit and vegetables and cut them into small piece separately.
2. Transfer the cut piece of various fruits and vegetables in mortar separately and crush them.
3. Take different beaker of each kind of fruits and vegetables and place the crushed fruit and vegetable in these beakers, and add 10ml of alcohol to each or these. Stir well and filter collect the filtrate in separate china dishes.
4. Evaporate the alcohol by heating china dishes one by one over water bath and let the residue dry in an oven.
5. Heat a small piece of dry sodium in a fusion tubes, till it melts. Then add one of the above residues from china dish to the fusion tube and heat till red hot. Drop the hot fusion tube in china dish containing about 110ml of distilled water. Break the tube and boil the contents of the china dish for about 5 minute to cool and filter solution. Collect the filtrate.
6. To the filtrate add 1ml freshly prepared ferrous sulphate solution and warm the contents. Then, add 2-3 drops of ferric chloride solution and acidity with the dil. Hydrochloric acid if a blue or green precipitate or colouration is obtained, it indicated the presence of nitrogen containing insecticide.
7. Repeat the test of nitrogen for residue obtained from other fruits and vegetable and record observation.

### **iv. Observation:**

Sl. No	Name of the fruit or vegetables	No of samples collected	No of samples shown + ve test	No of samples shown - ve test	Percentage of samples with pesticide
1	Tomato	20	12	8	60
2	Brinjal	20	12	8	60
3	Cow Beans	20	13	7	65
4	Cabbage	20	18	2	90
5	Bottel Guard	20	3	17	15
6	Ivy Guard	20	5	15	25
7	Ladies Finger	20	12	8	60
8	Green Peas	20	16	4	80
9	Radish	20	12	8	60
10	Carrot	20	12	8	60
11	Spinach	20	16	4	80
12	Coriander	20	15	5	75
13	Apple	20	13	7	65
14	Orange	20	13	7	65
15	Banana	20	18	2	90
16	Guava	20	2	18	10

## 5. Result and Analysis

The vegetable tomatos, potato, brinjal, spinach, are found to contain nitrogenous pesticides or insecticides where as carrot and radish gave negative result. Among the fruits grapes, apple, orange, banana, which we have examined were found to contain the above said pesticide in them.

From the experiment conducted in our laboratory it can be seen that a large concentration of pesticides is injected and absorbed into the fruits or fruits and vegetables may be exposed to pesticide spray.

## 6. Conclusion

Most of the vegetables and fruits which we have examined in the laboratory were found to contain nitrogen bearing pesticides The consumption of these fruits and vegetables cause health problems such as respiratory, memory disorders, cancer, depression neurological deficiency, miscarriages and birth defects in human being.

Pesticide exposure in children results in brain cancer, leukaemia and birth defects. hence we are going to bring awareness to the farmers of nearby villages of Jagtial district about minimization of pesticides usage as they are very much harmful for health.



From the experimental data, we came to know that most of the fruits and vegetables contain pesticide residues. Hence we are going to advice to students to use the fruits after washing with plenty of water and vegetables after soaking in salt water for few minutes.

Pesticide use has expanded extensively in the recent years, resulting in the environmental damage, particularly water and soil contamination. Pesticides come in a variety of forms, but organophosphates, organochlorine, carbamate, and pyrethroids are the most abundantly uses pesticides and have human and environmental concerns. Refined knowledge of various properties related to the physical and chemical background of pesticides are necessary to determine the impact and behavior of pesticide transformation in that environment. Such pesticides need proper management strategies for converting them to non-toxic compounds before releasing them into the environment.

Hence, the further studies on the screening of effective microbial strains and enzymes are essential to reduce pesticide risks for the environment and human health.

## 7. References

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### Photos in the Chemistry Lab



