



TECHNICAL BULLETIN



Current Status and Guidelines for Safe Use of Pesticides in Agriculture 2020

ICAR
NATIONAL INSTITUTE OF
BIOTIC STRESS
MANAGEMENT

Rendering solution to biotic stresses



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Current Status and Guidelines for Safe Use of Pesticides in Agriculture

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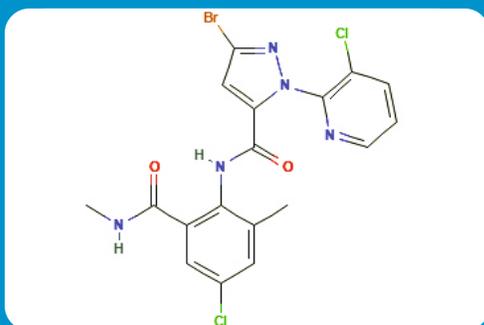
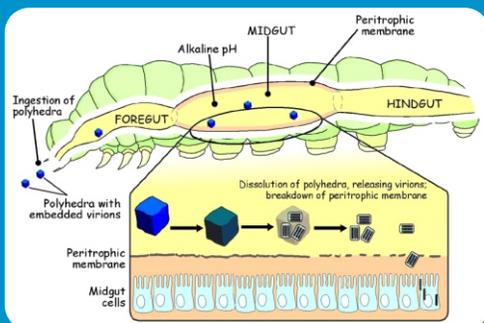
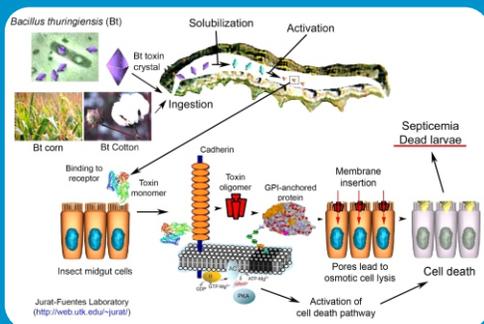
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COVER PHOTO TOP RIGHT : Pesticide spray man with safety kit

COVER PHOTO LEFT : Indian spray man

CURRENT PAGE PHOTO : Top - Bt Mode of Action

Middle - NPV Mode of Action

Bottom - Structural formula of
Chlorantraniliprole

Introduction

A United Nation study on global population trends predicts that India will surpass China to become the most populous nation in the world by 2022. With a present size of 1.32 billion, India currently supports nearly 17.84% of the world population, with 2.4% land resources and 4 % of water resources. Continuously shrinking arable land, slow pace of improvement in farm productivity and loss/wastage of crops both during and post-harvest poses a critical challenge to ensuring food and nutritional security for the nation. To add to the complexity, the agricultural workforce in India is expected to reduce by 50% in the coming decade due to better remuneration and growth opportunities in other sectors. It is also noted that about 15-25% potential crop production is lost due to insect pests, weeds and diseases.

It is imperative that to meet the needs and overcome the challenges, the focus needs to be on raising the agricultural production and enhancing productivity across the value chain simultaneously. A combination of Crop protection and Crop enhancement solutions will be critical in achieving the above mentioned objectives, viz. protecting the produce during and post-harvest and enhancing productivity. Use of chemical pesticides in the management of biotic stresses of agricultural and horticultural crops is inevitable practice in Indian agriculture.

The growth of Indian agro-chemical industries is enormous and India is the fourth largest global producer of agrochemicals after the US, Japan and China. At present, per hectare consumption of pesticides in India is amongst the lowest in the world and stands at 0.6 kg/ha against 5-7 kg/ha in the UK and 13 kg/ha in China. In recent years, with changes in the cropping systems and climate, and introduction of highly input intensive high yielding varieties/hybrids, a shift in pest status has been observed. Most of the plant protection recommendations in crops so far indicated the calendar based application of chemical insecticides. Around 272 pesticide molecules are registered and readily available in the market of India. Out of total insecticides used for pest management in India, 50% are diverted to cotton pest management. Due to over dependence and indiscriminate use of insecticides, many ill-effects including residue in plant parts, resistance to insecticides, secondary pest out-break, pollution to

Saleswise Top 20 Indian Agrochemical Companies (in Million Rupees)

Ranking (2017-18)

1. UPL Limited - 150,060
2. Gharda Group - 23,363
3. Indofil Industries - 17,490
4. Bharat Group - 15,678
5. Coromandel International - 15,060
6. Sharda Cropchem Limited - 14,881
7. Crystal Crop Protection - 13,649
8. Krishi Rasayan Group - 12,780
9. Rallis India - 12,117
10. PI Industry - 12,050
11. Sulphur Mills Limited - 12,000
12. Excel Crop Care - 11,880
13. Willowood Chemicals - 11,241
14. Insecticides India - 11,064
15. Meghmani Group - 9,698
16. Dhanuka Agritech - 9,626
17. NACL Industries Limited - 8,842
18. GSP - 8,200
19. Best Agrochem - 7,460
20. Heranba Industries Ltd. - 7,400

Source : news.agropages.com



Per capita usages of pesticide by country (Kg/Ha)

Source: news.agropages.com

natural resources, health complications for human and wildlife etc., warrant to switch over to eco-friendly pest management methods.

Out of eight lakhs deaths due to pesticide poisoning in developed countries, 2 lakhs people died in developing countries alone. Due to mass death of methyl parathion poisoning during 1958 in Kerala, ICAR, New Delhi and GoI enforced Insecticides Act, 1968 and Insecticide Rules, 1971 to regulate the import, manufacture, sale, transport, distribution and use of insecticides with a view to prevent risk to human beings or animals and for matters connected therewith. Since conventional insecticides like DDT, BHC, OP, OC etc. are having high residual toxicity, many new molecule pesticides with novel chemistries and formulations like water emulsifiable gel, floating granules, drift less dust, macro and micro encapsulated suspension, hollow fibers, monolithic matrix, laminated structures etc. can avoid these problems have been brought in to the market by the multinational companies which are required in small quantities to cause expected control and also leave minimal ill-effect to environment, natural resources, human beings, higher animals, non-target organism etc.

Another problem what we had been facing since 1940 is the development of resistance to insecticides. Due to abuse of insecticides, around 340 species of insects developed resistance to many insecticide molecules which need to be addressed/resolved through Insecticide Resistance Management (IRM). Though India consumes less quantity of pesticides per hectare, contamination/pollution level is high when compared to developed countries. This situation will sustain in India till Good Agricultural Practices and Safe handling of Pesticides are not followed while using pesticides in plant protection.

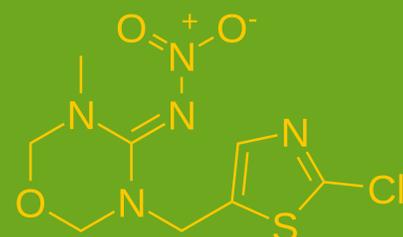
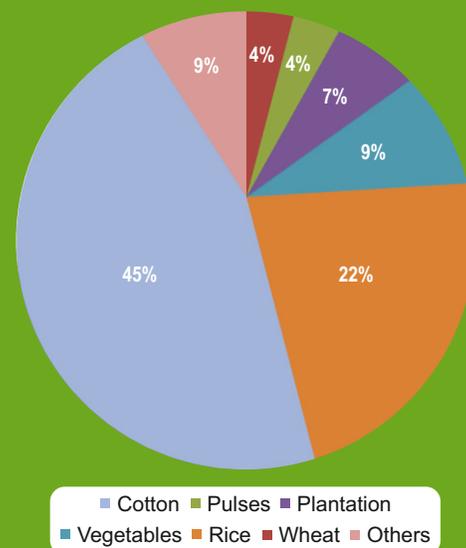


The United Nations Population Division estimates that, by the year 2050, there will be 9.7 billion people on Earth – around 30% more people than in 2017. Nearly all of this population growth will occur in developing countries. ”



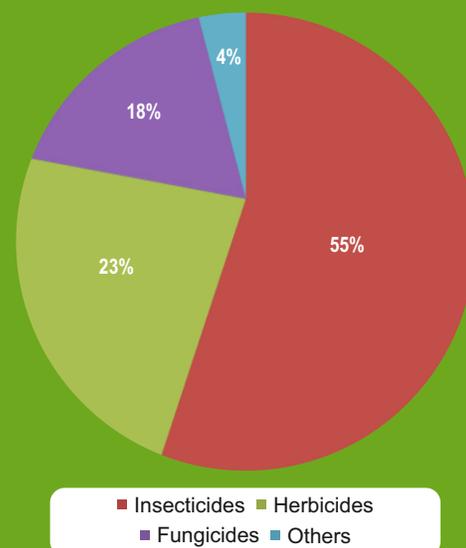
The Food and Agriculture Organization of the United Nations (FAO) estimates that, in developing countries, 80% of the necessary increases in food production keep pace with population growth are projected to come from increases in yields and the number of times per year crops can be grown on the same land. Only 20% of new food production is expected to come from expansion of farming land. ”

Crop wise consumption of pesticides in India



Thiamethoxam chemical structure

Indian crop protection chemical-usage pattern



Source: news.agropages.com

Insecticides Act, 1968 and Insecticide Rules, 1971

Objectives

To regulate the import, manufacture, sale, transport, distribution and use of insecticides with a view to prevent risk to human beings or animals and for matters connected therewith.

Salient features

- ❖ Compulsory registration of the product at the Central level and licences for manufacture, formulation and sale at the State level
- ❖ The high level advisory board 'Central Insecticides Board' drawn from various field having expert knowledge of the subject to pursue the registration of pesticides
- ❖ Registration Committee to look after the registration aspects of all insecticides
- ❖ Establishment of machinery or system like insecticide analysts and insecticide inspectors by the Central or State Government
- ❖ Establishment of Central laboratory
- ❖ Power to prohibit the import, manufacture and sale of pesticides and also confiscate the stocks. The offences are punishable and size and other penalties are prescribed
- ❖ Both the Central and State Governments are empowered to make rules, prescribe forms and fees

The Central Insecticide Board

The Central Government constitute a Central Insecticide Board (CIB) to advise the Central Government and State Governments on technical matters arising out of the administration of this Act and to carry out the other functions assigned to the Board by or under the this Act.

The Board advises on matters relating to

- ❖ The risk to human beings or animals involved in the use of insecticides and the safety measures unnecessary to prevent such risk
- ❖ The manufacture, sale, storage, transport, distribution of insecticides with a view to ensure safety to human beings or animals



सत्यमेव जयते

Ministry of Agriculture and Farmers' Welfare
Government of India

Directorate of Plant Protection,
Quarantine & Storage

Central Insecticides Board &
Registration Committee

Central Integrated Pest
Management Centre



भारत अन्न
ICAR
Indian Council of
Agricultural Research



रा व स्वा प्र सं
NIPHM

National Institute of
Plant Health Management



*It is also possible, under certain
circumstances, to produce food without
the use of pesticides.*

WHO, 2020



Other components of CIB&RC

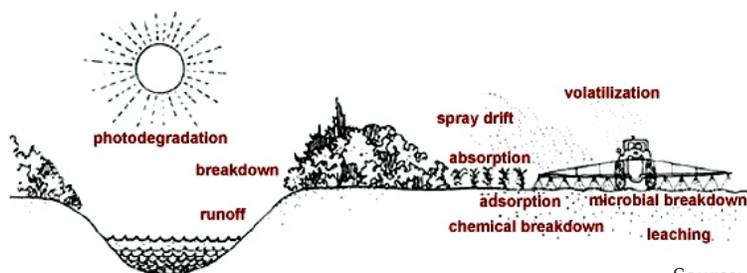
- ❖ Registration Committee
- ❖ Registration of insecticide
- ❖ Grant of License
- ❖ Central Insecticide Laboratory
- ❖ Insecticide Inspectors

The Insecticide Rules, 1971

There are nine chapters in the Insecticide Rules 1971, Chapter I consists (1) short title and (2) definitions of the terms used in the Rules

- ❖ Chapter II; 3, 4, 5 - Functions of the Board, Registration Committee and Laboratory
- ❖ Chapter III deals about registration of insecticides
- ❖ Chapter IV deals about grant of licences
- ❖ Chapter V deals about packing and labelling
- ❖ Chapter VI deals about roles of Insecticide Analyst and Insecticide Inspectors
- ❖ Chapter VII deals about manner of packing and storage while in transit by rail
- ❖ Chapter VIII deals about protective clothing, equipment and other facilities for workers during manufacture of insecticides
- ❖ Chapter IX deals about Miscellaneous

“ The **Waiting Period** is the minimum length of time you must wait after applying the pesticide before it is safe to harvest the crop. Do not harvest crops (especially vegetables) until the waiting period for the pesticide has passed. Pesticides leave residues on crops. Observe the waiting period specified on the label or recommended by your extension worker. The waiting period depends on the type of crop, the pesticide used, and the dosage. ”



Source: uky.edu

Pesticide toxicity labels



Extremely toxic
Ex. Zinc phosphide



Highly toxic
Ex. Quinalphos



Moderately toxic
Ex. Malathion, Thiram, Glyphosate



Slightly toxic
Ex. Mancozeb, Allethrin, Pyrethrum

New Pesticides Management Bill, 2018

The salient features of the bill may be noted:

- ❖ The Pesticides Management Bill seeks to replace the Insecticides Act, 1968
- ❖ The draft came into wake of several pesticide-related deaths in recent months
- ❖ The draft bill proposes an increase in penalties on sale of spurious, substandard and misbranded pesticides and gives State Governments more power to deal with the issue and take action against them
- ❖ The draft contains clauses relating to allowance of provisional registration of new pesticides in India in case of “*national exigency*” for a period of 2 years
- ❖ The draft provides for punishment to anyone who 'uses' a pesticide in contravention to the provisions of this Act
- ❖ The draft provides for punishment to anyone who 'uses' a pesticide in contravention to the provisions of this Act
- ❖ The proposed Bill provides for paying of compensation to the affected farmers or users under the provisions of Consumer Protection Act, 1986
- ❖ The Bill contains detailed clauses for registration of new molecules
- ❖ It has also tightened the guidelines for registration and licensing of new molecules
- ❖ It includes a broader category of offences and provisions for paying compensation to the farmers

List of points which have been modified in the existing Insecticides Act, 1968

Topic	The Insecticides Act, 1968	The Pesticide Management Bill
Coverage	This act covers insecticides which are defined as any substance included in the Schedule to the Act	This Bill covers pesticides which are defined as any substance of chemical or biological origin used to control the spread of pests in agricultural commodities or animal feed
Powers of registration Committee	Power to cancel the registration of an insecticide lies with the central Government	Committee can suspend or cancel registration in case of violations of the Act or by adverse impact on crops, humans or animals
Conditions and process of registration	The Act did not require tolerance limits for pesticide residues to be specified. Tolerance limits are specified under the Prevention of Food Adulteration Act, 1954	Bill requires tolerance limits to be specified as a condition for registration. Such limits are specified by the Food Safety and Standards Authority, set up under the Food Safety and Standards Act, 2006
Provision for protection of data of applicants	There is no protection of data submitted for registration. Same data could be used by multiple applicants	Data submitted for registration by one applicant cannot be used by others for three years, without permission

Good Agricultural Practices

- ❖ Good Agricultural Practices (GAP) are "practices that address environmental, economic and social sustainability for on-farm processes, and result in safe and quality food and non-food agricultural products" (FAO)
- ❖ Four 'pillars' of GAP (economic viability, environmental sustainability, social acceptability and food safety and quality) are included in most private and public sector standards, but the scope which they actually cover varies widely

Objectives of GAP

- ❖ Ensuring safety and quality of produce in the food chain
- ❖ Capturing new market advantages by modifying supply chain governance
- ❖ Improving natural resources use, workers health and working conditions, creating new market opportunities for farmers and exporters in developing countries

Key Elements of GAP

- ❖ Prevention of problems before they occur
- ❖ Risk assessments
- ❖ Commitment to food safety at all levels
- ❖ Communication throughout the production chain
- ❖ Mandatory employee education program at the operational level
- ❖ Field and equipment sanitation
- ❖ Integrated pest management
- ❖ Oversight and enforcement
- ❖ Verification through independent, third-party audits

Potential benefits of GAP

- ❖ Appropriate adoption and monitoring of GAP helps improve the safety and quality of food and other agricultural products
- ❖ It may help reduce the risk of non-compliance with national and international regulations, standards and guidelines (CAC / OIE / IPPC)
- ❖ Adoption of GAP helps promotes sustainable agriculture and contributes to meeting national and international environment and social development objectives



Know how to protect yourself



Know about keep out signs



Warn people about pesticide applied area



Leave the closed area if you feel sick

Challenges related to GAP

- ❖ GAP implementation and especially record keeping and certification will increase production costs
- ❖ There is a high risk that small scale farmers will not be able to seize export market opportunities
- ❖ Compliance with GAP standards does not always foster all the environmental and social benefits, which are claimed

Pesticide use

- ❖ If improperly used, products used to control pests in the field can contaminate the environment or leave potentially harmful residues on the crop

This GAP applies to

- ❖ All farms that apply pesticides, including products used in organic production

What needs to be done

- ❖ Make sure pesticides are used properly and, if required, applied by someone who knows safe handling of pesticides and regulations

How to do it

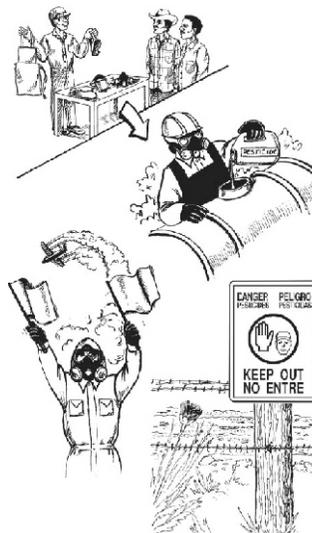
- ❖ Check the label and use only pesticide products registered for use
- ❖ Use only on crops specified and for weeds or pests indicated on the label
- ❖ Read and follow all label directions. Even if the product has been on the market for years, application rates and usage information may change

Apply pesticides appropriately

- ❖ Make sure applications are done by experienced applicator with all protective measures
- ❖ Apply pesticides under the right environmental conditions to reduce the possibility of spray drift, run-off or leaching that may contaminate other crops. Check the product label for details
- ❖ Maintain and calibrate the application equipment to deliver the correct rate
- ❖ Double-check calculations to make sure the application rate is correct according to the rate given on the label
- ❖ Clean and rinse equipment using the manufacturer's recommended procedures between applications to prevent carry over and contamination



Never take pesticides to home from work



Get yourself trained for pesticide use



Read the signs and label information

- ❖ Follow the pre-harvest interval (PHI) and the waiting period requirements on the label. This ensures that no produce is harvested and that no animals graze on a treated field until the legal number of days after the application has passed. Failure to wait may result in residues exceeding the maximum residue limit in the crop or contamination of the milk and/or meat
- ❖ In the event that harvesting occurred before the PHI, segregate the product

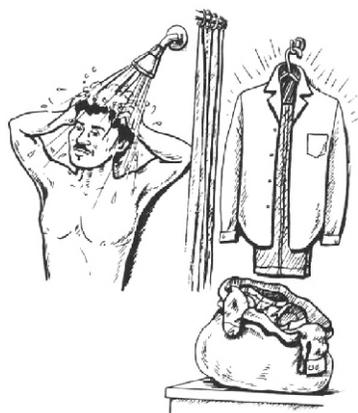
In general

- ❖ If there are concerns about residues, hold or separate the product and discuss options with an agricultural specialist / government agencies

Records to keep

- ❖ Application date
- ❖ Chemical applied
- ❖ Rate applied
- ❖ Weather conditions
- ❖ Crop and stage of growth
- ❖ Target pest(s)
- ❖ Field identification, location and size
- ❖ Earliest possible harvest/ grazing date
- ❖ Date of harvest/ grazing
- ❖ Initials of applicator

Source: www.imafra.gov.on.ca
Tamil Nadu Agricultural University



After work, shower with soap and water, shampoo your hair, and put on clean clothes

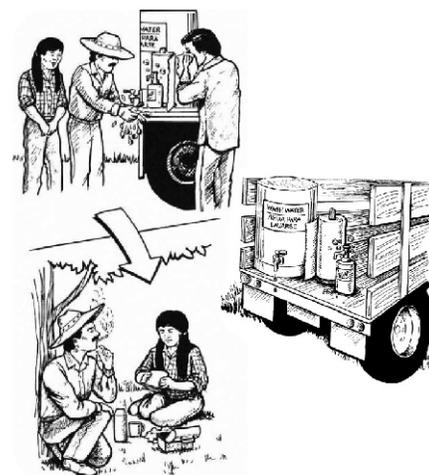


Act quickly if you get a pesticide in your eyes

Image courtesy:



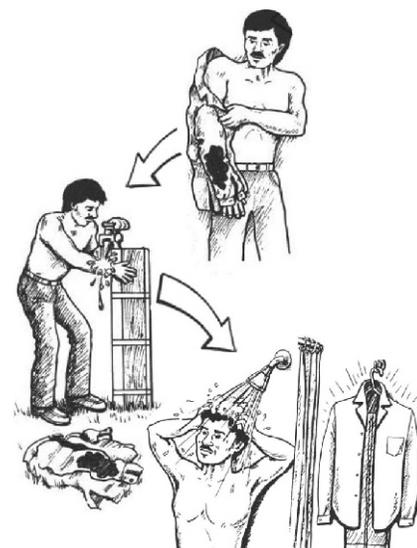
OREGON.GOV
www.cbs.state.or.us



Wash your hands before eating

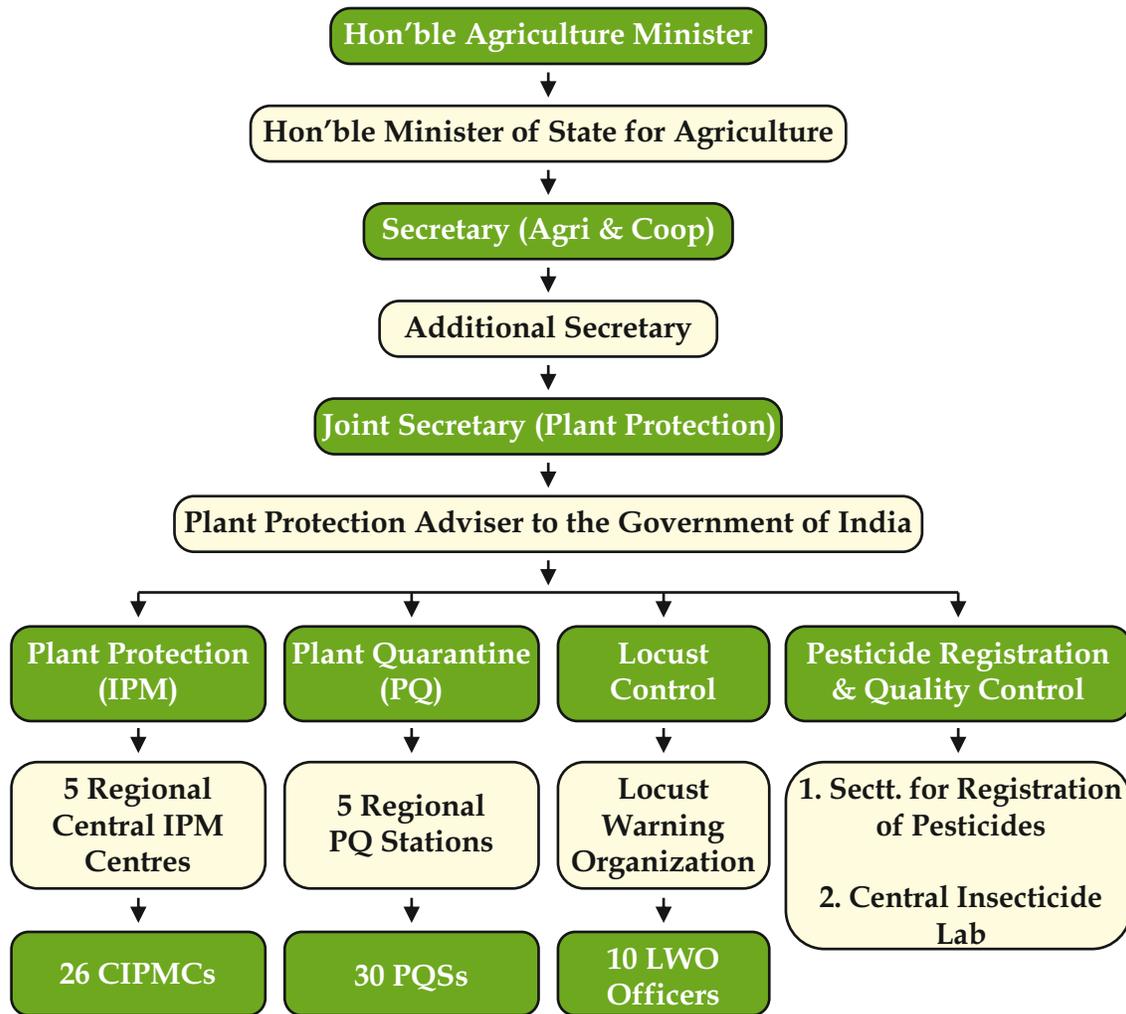


Wash hands before and after using the toilet

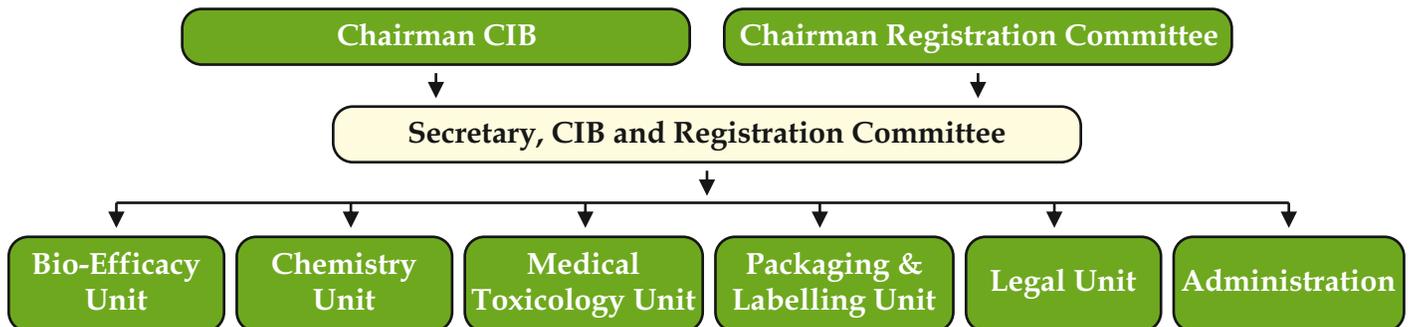


Act quickly if pesticide is spilled/sprayed on you

A. Organogram of plant protection organisation in India



B. Organogram of Central Insecticides Board (CIB) and Registration Committee



Website : <http://ppqs.gov.in/>
 Directorate of Plant Protection, Quarantine & Storage, Government of India

Pesticides consumption scenario in India and world

Consumption of chemical pesticides in various States/UTs during 2014-15 to 2018-19

As on 28.11.2019

Unit: Quantity in MT Tech. Grade

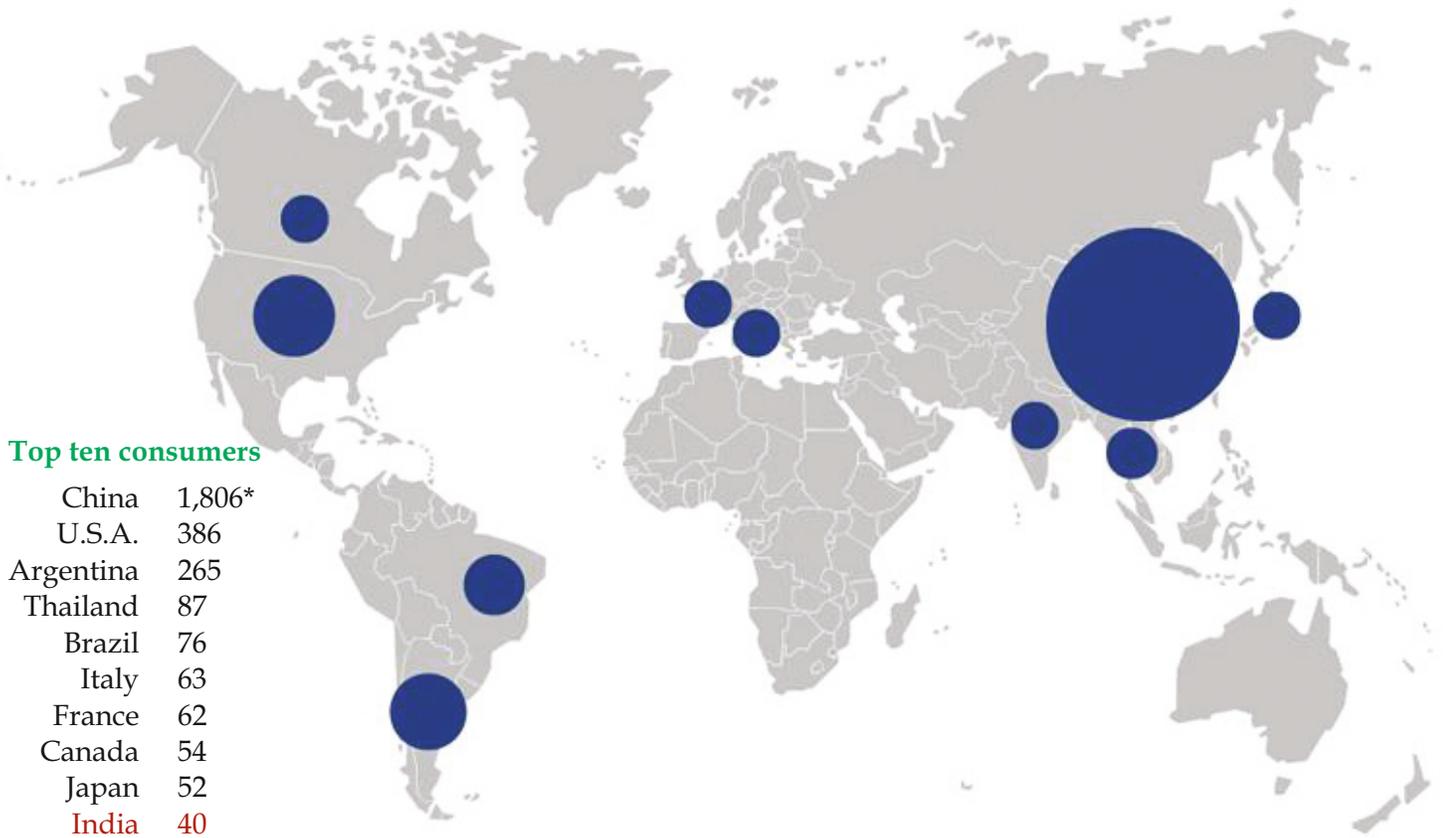
S. No.	States/UTs	2014-15	2015-16	2016-17	2017-18	2018-19
1	Andhra Pradesh	4050	2713	2015	1738	1689
2	Bihar	787	831	790	840	850
3	Chhattisgarh	1589	1625	1660	1685	1770
4	Goa	12	48	2	24	25
5	Gujarat	1730	1980	1713	1692	1608
6	Haryana	4070	4100	4050	4025	4015
7	Himachal Pradesh	379	450	341	467	322
8	Jharkhand	650	493	541	619	646
9	Karnataka	1793	1434	1288	1502	1524
10	Kerala	910	1123	895	1067	995
11	Madhya Pradesh	696	732	694	02	540
12	Maharashtra	8663	1166	1349	1556	1174
13	Orissa*	1278	994	1050	1633	1609
14	Punjab	5689	5743	5843	5835	5543
15	Rajasthan	2694	2475	2269	2307	2290
16	Tamil Nadu	2096	2096	2092	1929	1901
17	Telangana	2806	993	3436	4866	4894
18	Uttar Pradesh	9736	1045	1061	1082	1104
19	Uttarakhand	172	217	198	210	195
20	West Bengal	3060	3712	2624	2982	3190
Sub Total		52859	53881	55631	60316	56402
North-Eastern						
21	Arunachal Pradesh	18	17	18	NR	5
22	Assam	190	185	306	241	256
23	Manipur	31	30	33	27	NR
24	Meghalaya	28	NR	NR	NR	NR
25	Mizoram	805	NR	9	NR	26
26	Nagaland	20	20	20	20	21
27	Sikkim	<i>Organic State</i>				
28	Tripura	346	293	298	330	349
Sub Total		1437	544	684	617	657
Union Territories						
29	Andaman & Nicobar	8	NR	NR	NR	NR
30	Chandigarh	NR	NR	NR	NR	NR
31	Dadra & Nagar Haveli	NR	NR	NR	NR	NR
32	Daman & Diu	NR	NR	NR	NR	NR
33	Delhi	NR	NR	88	NR	110
34	Jammu & Kashmir	1921	2251	2188	2430	2459
35	Ladakh					Formed in Oct,19
36	Lakshadweep		NR	NR	NR	NR
37	Pondicherry	42	43	43	43	42
Sub Total		1971	2295	2319	2473	2611
Grand Total		56268	56720	58634	63406	59670

Source: States/UTs Zonal Conferences on Inputs (Plant Protection).

*Revised data has been provided by State for 2014-15 to 2018-19.

For further details visit www.ppq.gov.in

Consumption of chemical pesticides in various countries



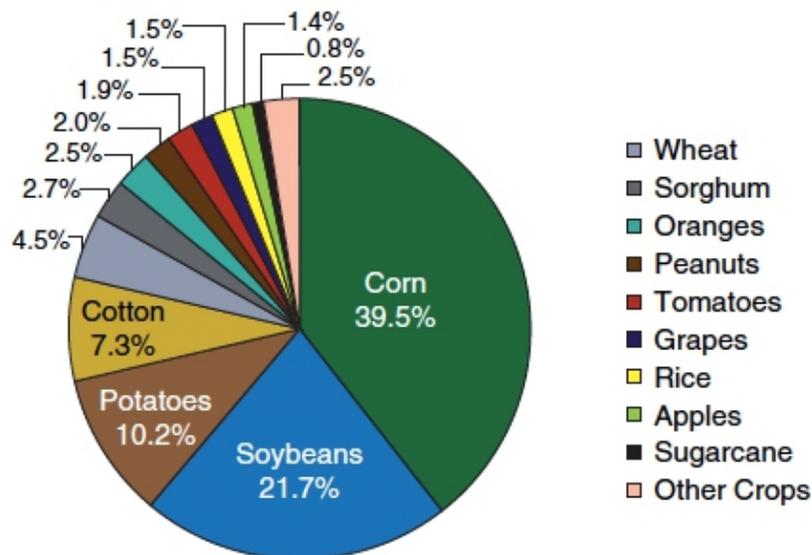
Top ten consumers

China	1,806*
U.S.A.	386
Argentina	265
Thailand	87
Brazil	76
Italy	63
France	62
Canada	54
Japan	52
India	40

*millions of kilograms

Sources: Pretty and Bharucha, *Insects*, 2015, FAOSTAT, OECD.

World pesticide usage by crop



Source: USDA, 2015

Spray fluid preparation

$$\text{Quantity of insecticide required} = \frac{\text{Volume of spray fluid} \times \text{Strength of spray solution desired (\%)}}{\text{Strength of commercial formulation (\%)}}$$

Cal 1. What is the quantity of chlorantraniliprole 18.5% required to cover one hectare of rice with high volume/hand operated sprayer at spray solution strength of 0.02%

$$18.5 \times Y1 = 0.02 \times 200000 \quad Y1 = \frac{0.02 \times 200000}{18.5} = 216 \text{ ml}$$

Cal 2. What is the quantity of water required to spray 150 ml of thiamethoxam 25% WG in rice at spray solution strength of 0.046% and 0.014%

$$18.5 \times 150 = 0.046 \times Y2 \quad Y2 = \frac{18.5 \times 150}{0.046} = 60 \text{ lit}$$

$$18.5 \times 150 = 0.014 \times Y2 \quad Y2 = \frac{18.5 \times 150}{0.014} = 200 \text{ lit}$$

$$\text{Strength of spray fluid} = \frac{\text{Quantity of the insecticide required} \times \text{Strength of commercial formulation}}{\text{Strength of spray solution desired}}$$

Cal 3. What is the strength of spray fluid of fipronil 5% SC when 100 gram is applied one hectare area through high volume sprayer

$$5 \times 100 \text{ g} = X2 \times 200000 \quad X2 = \frac{5 \times 100 \text{ g}}{200000} = 0.003\%$$

In case of granules or herbicides/recommended as kg ai/ha

Quantity of chemical needed = Recommended dose a.i./ha \times 100 \times Area

Cal 4. Find out the quantity of flubendiamide 20% WG to be sprayed in one hectare area if rate of application is 3 kg a.i. /ha

$$\text{Quantity required} = 3/20 \times 100 = 15 \text{ kg/ha}$$

Cal 5. How many areas can be covered with 300 ml phosalone 35 EC at the strength of 0.26%

$$35 \times 300 \text{ ml} = 0.26 \times Y2 \quad Y2 = \frac{35 \times 300 \text{ g}}{0.26} = 40 \text{ lit}$$

0.2 ha with high volume sprayer; 0.6 ha with low volume sprayer

Pesticide formulation and mode of action

Pesticide formulations

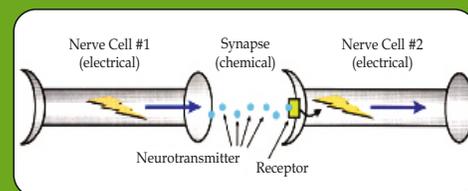
Pesticide formulation is composed of active ingredient and inert materials. The active ingredients, in “pure” (technical grade) form, are not suitable for application. In their concentrated form, some are extremely toxic, many do not mix well with water, some are unstable, and some are difficult (or unsafe) to handle, transport, or store. To address these problems, manufacturers add inert ingredients to end-use pesticide products. Inert ingredients have no pesticidal activity, and some simply serve as diluents or carriers. In many cases, inert ingredients make the formulated product safer, easier to handle and apply, and/or more effective.

Different kinds of formulations

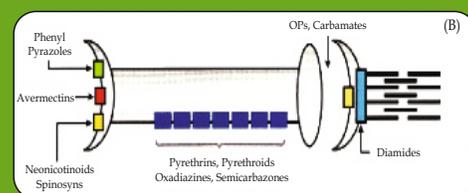
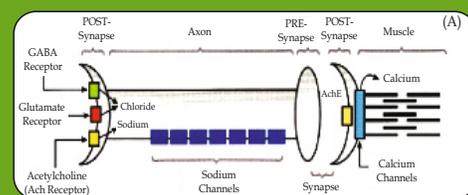
A	Aerosol	M	Microencapsulated
AF	Aqueous flowable	P	Pellets
B	Bait	RTU	Ready-to-use
C	Concentrate	S	Solution
D	Dust	SP	Soluble powder
DF	Dry flowables	ULV	Ultra-low volume
EC	Emulsifiable Concentrate	WP	Wettable powder
F	Flowable	WDG	Water-dispersible granules
G	Granules	WS	Water soluble
GL	Gel	WSB	Water-soluble bag
L	LIEQUID	WSC	Water soluble concentrate
LC	Liquid Concentrate	WSL	Water-soluble liquid
LV	Low Volatile	WSP	Water-soluble powder

Mode of Action

Insecticides have chemical structures that allow them to be classified based on the commonality of the active ingredient's chemistry. Thus, all members of an insecticide class have similar characteristics. The chemical structure of an insecticide generally defines its target site and its mode of action at that target site. Target site is defined as the physical location within an organism where the insecticide acts. Mode of action, alternatively, is defined as the action of an insecticide at its target site. In other words, the mode of action of an insecticide is the way in which it causes physiological disruption at its target site. Therefore, insecticide class, target site and mode of action are highly inter-connected concepts.

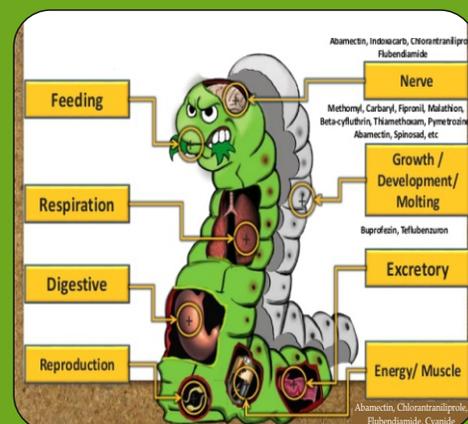


The nervous system in insects is composed of a series of interconnected cells, called neurons, along which travel electrical charges called impulses. Impulses are carried from the end of one nerve cell across the synapse (i.e., the space separating neurons) by a chemical messenger called a neurotransmitter.

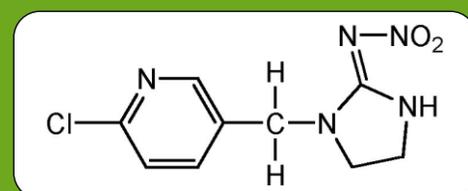


Neurological target site of various insecticide classes used by the urban and structural pest management industry.

Source : Michael E. Scharf et al. (2011)



A specific Mode of Action will target a specific part/function of an insect



Imidacloprid structural formula

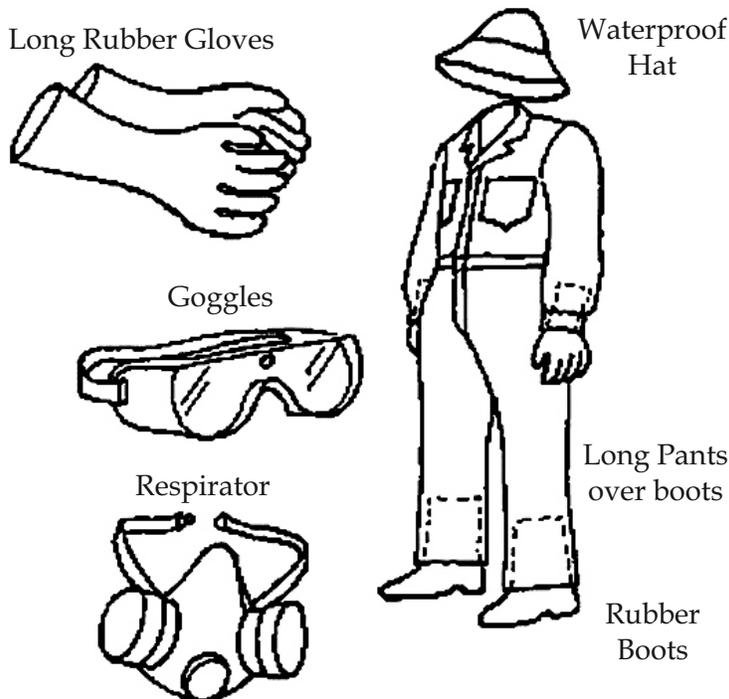
Pesticide applicator safety kit

Pesticides can enter the body four ways:

- ❖ Skin
- ❖ Eyes
- ❖ Mouth
- ❖ Lungs

Skin contact is the most common cause of pesticide poisoning for applicators and some pesticides enter the body through the skin quite readily. At the time of mixing, pesticides are more concentrated and the likelihood of injury is increased during this time. Some parts of the body absorb pesticides extremely fast (within a few minutes) and need extra protection. Two such areas are the head and body area between the navel and about mid-thigh. If any pesticide is spilled in this area, wash it off immediately and change clothing. It is best to avoid direct contact with pesticides by wearing the proper Personal Protective Equipment (PPE) as specified on the label of the pesticide you intend to use. It will look something like the example below and will more than likely be located on the front page of the label.

Parts of Personal Protective Equipment (PPE)



Symptoms and tips to avoid pesticide poisoning

Pesticide poisoning

Pesticide poisoning occurs when chemicals intended to control a pest affect non-target organisms such as humans, wildlife, or bees. There are three types of pesticide poisoning. The first of the three is a single and short-term very high level of exposure which can be experienced by individuals who commit suicide, as well as pesticide formulators. The second type of poisoning is long-term high-level exposure, which can occur in pesticide formulators and manufacturers. The third type of poisoning is a long-term low-level exposure, which individuals are exposed to from sources such as pesticide residues in food as well as contact with pesticide residues in the air, water, soil, sediment, food materials, plants and animals

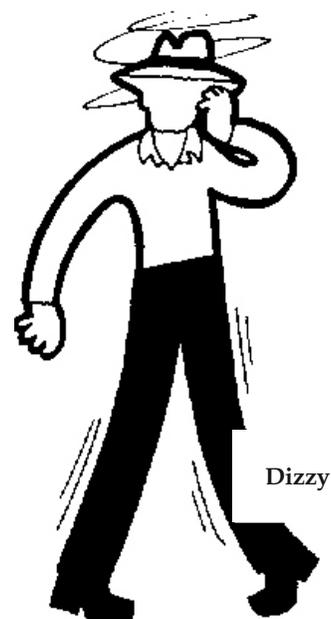
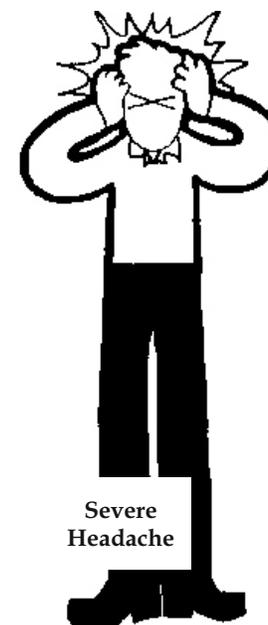
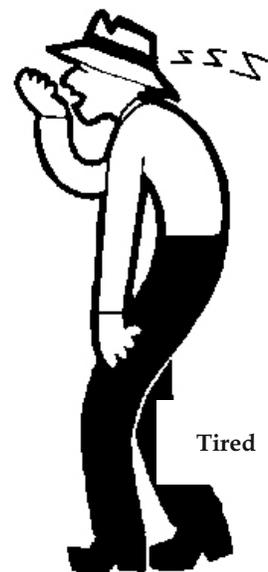
Types of pesticide poisoning

Acute poisoning : This happens when someone has been exposed to a high dose of pesticide. This could occur when the pesticide is being mixed, for example, or if a hose breaks drenching the person or bystanders with liquid pesticide solution. Another example might be accidental ingestion of a pesticide, such as a child swallowing the chemical.

Chronic poisoning : This results from a person being exposed to a small amount of pesticide on many occasions over a long period of time. Chronic poisoning may happen when the operator repeatedly uses pesticide improperly, especially if they does not wear protective clothing and equipment or wears protective clothing which is not clean or is worn out, like wearing cracked or torn gloves.

Symptoms of pesticide poisoning

There are a number of symptoms(signs) which may indicate that pesticides may be affecting a person's health. However, these symptoms may be caused by other illnesses. The possibility of poisoning should always be considered when a person may have been exposed to pesticides.



Symptoms of mild poisoning

- ❖ Headache
- ❖ Sweating
- ❖ Diarrhoea
- ❖ Irritation of nose and throat
- ❖ Eye irritation
- ❖ Nausea
- ❖ Fatigue
- ❖ Changes of mood
- ❖ Skin irritation
- ❖ Insomnia
- ❖ Loss of appetite
- ❖ Thirst
- ❖ Weakness
- ❖ Restlessness
- ❖ Dizziness
- ❖ Sore joints
- ❖ Nervousness

First aid - acute pesticide poisoning

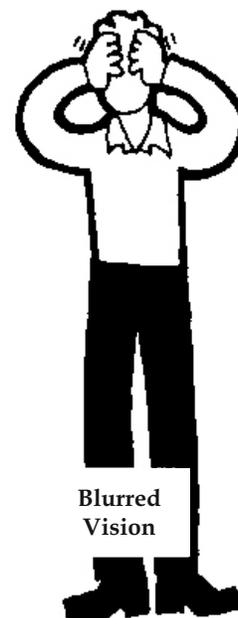
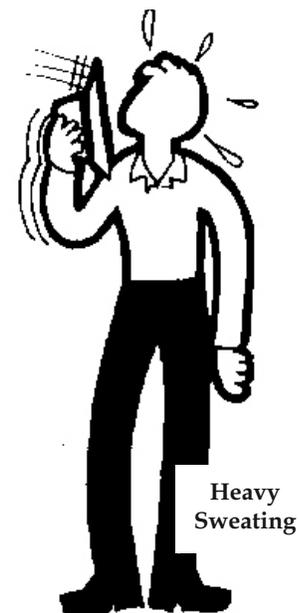
- ❖ Find out if possible the way the poison entered the body. This may either be through the mouth, nose, skin or eyes
- ❖ If the pesticide has been inhaled, move the person to fresh air
- ❖ If the pesticide is in the eyes, quickly wash the eyes for 15 minutes with clean, gently running water. If there is no running water, bathe eyes from a container, frequently changing the water
- ❖ If the pesticide is on the skin, remove all contaminated clothing and wash the affected area thoroughly with soap and water
- ❖ If the patient is not breathing, apply artificial respiration if possible
- ❖ Read the label on the pesticide container for any first aid instructions and keep the label for the doctor. It is very important to be able to tell the doctor the name of the pesticide
- ❖ If the pesticide is swallowed, and only if the person is conscious, rinse the mouth with plenty of water and read the label on the pesticide container for further instructions
- ❖ Quickly arrange for the doctor, or Community Nurse or Health Worker to be called or take the person to the doctor, clinic or hospital immediately
- ❖ Keep the patient warm and comfortable

Symptoms of severe poisoning

- ❖ Vomiting
- ❖ Convulsions
- ❖ Loss of reflexes
- ❖ Unconsciousness
- ❖ Inability to breathe
- ❖ Fever
- ❖ Muscle twitching
- ❖ Thirst
- ❖ Constriction of eye pupils
- ❖ Increased rate of breathing

Potential systemic effects

- ❖ Damage to nerves
- ❖ Reduced ability of blood to clot
- ❖ Some cancers
- ❖ Reproductive problems
- ❖ Impaired metabolism
- ❖ Hormonal effects
- ❖ Damage to various organs



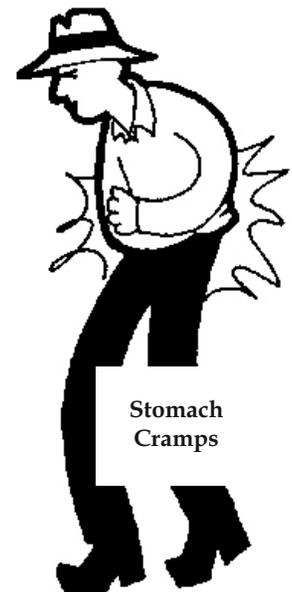
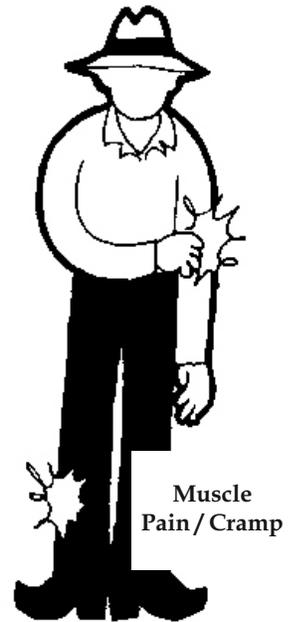
Key points to remember when administering first aid during a pesticide emergency

Oral or dermal exposure:

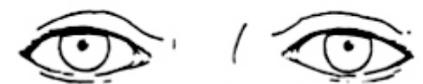
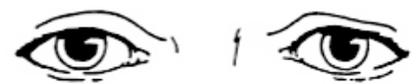
- ❖ Remove all contaminated clothing immediately
- ❖ Rinse the exposed area with water to dilute the pesticide and to prevent skin absorption. Use the cleanest water available
- ❖ Wash the affected area, including the hair, with water and soap. Then, rinse well. Showering is better than bathing to avoid prolonged contact with pesticide residues. Avoid harsh scrubbing, which could damage the skin and enhance pesticide absorption. Gently dry the affected area and wrap it in loose cloth or a blanket, if necessary
- ❖ If the skin has chemical burns, cover the area loosely with a clean, soft cloth. Do not use ointments, greases, powders, and other medications unless instructed to do so by a medical authority
- ❖ Never try to give an unconscious person anything by mouth
- ❖ Do not induce vomiting unless the label tells you to
- ❖ If inhalation exposure has occurred, get the victim to fresh air immediately
- ❖ Become familiar with the proper techniques of artificial respiration. It may be necessary if a person's breathing has stopped or becomes impaired
- ❖ If first responders are likely to be directly exposed to a pesticide, be sure they wear appropriate PPE

Pesticide in the Eyes

- ❖ Because eyes readily absorb material, fast action is required
- ❖ Hold the eyelid open and immediately begin gently washing the eye with drips of clean water. Do not use chemicals or drugs in the wash water unless instructed to do so by a medical professional or a poison control center
- ❖ Drip the water across not directly into the eye, or use an eyewash dispenser
- ❖ Continuously rinse the eye for 15 minutes. If only one eye is affected, be careful not to contaminate the other eye
- ❖ Flush under the eyelid with water to remove debris
- ❖ Cover the eye with a clean piece of cloth and seek medical attention immediately



Normal pupils



Constricted (pinpoint) pupils after pesticide poisoning

Image courtesy: www.iceagefarmer.com

Pesticide facts

- Exposure to pesticide during pregnancy can trigger autism in unborn child
- Pesticide induces development disorder in children
- Pesticide is turning agricultural soil toxic
- Pesticides is depleting bio-diversity

Inhaled Pesticide

- ❖ Immediately carry the victim to fresh air (do not allow him or her to walk)
- ❖ Do not attempt to rescue someone who is in an enclosed, contaminated area unless you are wearing appropriate PPE
- ❖ Warn other people in the area of the danger
- ❖ Have the victim lie down and loosen his or her clothing
- ❖ Keep the victim warm and quiet. Do not allow him or her to become chilled or overheated
- ❖ If the victim is convulsing, protect his or her head, turn the head to the side, and watch that breathing continues. Do not attempt to insert anything into the person's mouth during a seizure
- ❖ Keep the person's chin up to ensure that air passages are open for breathing
- ❖ Give artificial respiration if breathing stops or is irregular



Pesticides can make you feel sick in different ways

Pesticide in the Mouth or Swallowed

- ❖ If pesticide is in someone's mouth but has not been swallowed, rinse the mouth with plenty of water. Then, give the victim large amounts (up to 1 quart) of milk or water to drink
- ❖ If the pesticide is swallowed, one of the most critical first aid decisions is whether to induce vomiting. Induce vomiting only if the label instructs you to do so. Several pesticides cause more harm when vomited than if they remain in the stomach. To provide first aid for a swallowed pesticide, you must know the appropriate treatment. The decision to induce vomiting must be made quickly and accurately the victim's life may depend on it

Never induce vomiting if the victim

- ❖ Is unconscious or having convulsions
- ❖ Has swallowed a corrosive poison, such as a strong alkali or acid. The material burns the throat and mouth as severely coming up as it did going down. Also, it can be aspirated into the lungs and cause more damage
- ❖ Has swallowed an emulsifiable concentrate or oil solution product, which is dissolved in petroleum solvents. Emulsifiable concentrates and oil solutions may be fatal if aspirated into the lungs during vomiting



Wear clothes that cover your skin when you work where pesticides have been used

Medical antidotes for pesticide poisoning

Group	Pesticide Groups	Antidotes
I	Organophosphates	<ul style="list-style-type: none"> ❖ Atropine Sulfate is used to counteract the effects of cholinesterase inhibitors. Injections should be repeated as symptoms recur ❖ Protopam Chloride (2-PAM) should also be injected to counteract organophosphate poisonings. It is given intravenously ❖ Do not use morphine, theophyllin, aminophyllin or barbituates
II	Carbamates	<ul style="list-style-type: none"> ❖ Atropine Sulfate is used to counteract the effects of cholinesterase inhibitors. Injections should be repeated as symptoms recur ❖ Do not use Protopam Chloride (2-PAM)
III	Chlorinated Hydrocarbons	<ul style="list-style-type: none"> ❖ Barbiturates for convulsions or restlessness ❖ Calcium Gluconate given intravenously ❖ Do not use epinephrine (adrenalin)
IV	Inorganic Arsenicals	<ul style="list-style-type: none"> ❖ BAL (dimercaprol) is specific for arsenic poison. Inject intramuscularly
V	Cyanides	<ul style="list-style-type: none"> ❖ Amyl Nitrite through inhalation ❖ Sodium Nitrite given intravenously ❖ Sodium Thiosulfate given intravenously
VI	Anticoagulants	<ul style="list-style-type: none"> ❖ Vitamin K orally, intramuscularly, or intravenously ❖ Vitamin C useful adjunct
VII	Fluoroacetates	<ul style="list-style-type: none"> ❖ Monacetin (glycol monoacetate) intramuscularly
VIII	Dinitrophenols	<ul style="list-style-type: none"> ❖ Do not use atropine sulfate ❖ Maintain life supports ❖ Sodium Methyl Thiouracil may be used to reduce basal metabolic rate
IX	Bromides and Carboxides	<ul style="list-style-type: none"> ❖ BAL (dimercaprol) may be given before symptoms appear ❖ Barbiturates for convulsions
X	Chlorophenoxy Herbicides, Ureas, Miscellaneous	<ul style="list-style-type: none"> ❖ None and maintain life supports

Checklist for preventing pesticide accidents

Everyone can improve their methods for safe handling of pesticides:

Experienced pesticide applicators, unfortunately, may become so familiar with the equipment and materials used that they become careless or take shortcuts. An accident is waiting to happen. The following checklist of questions is drawn from data showing the common causes of pesticide accidents. Check it against your pesticide handling practices and see how many accidents are waiting to happen to you. Just one "No" may be the one that gets you in trouble!

Store your pesticides safely

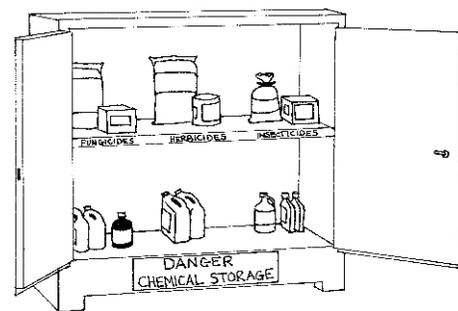
- ❖ Do you have a separate space to store pesticides?
- ❖ Do you keep it locked and are the windows tight, barred or boarded over?
- ❖ Do you keep all your pesticides in this storage rather than in the garage, feed room, basement, porch, kitchen or refrigerator?
- ❖ Do you store herbicides separately from other pesticides?
- ❖ Are there signs on your storage so firemen and others are warned?
- ❖ Do you check periodically for leaking containers?

Use the recommended clothing and protective equipment

- ❖ Do you read the label to see what protective clothing you should wear?
- ❖ Do you start each spraying day with clean spray clothing?
- ❖ Do you check the signal words and precautions for use on the label to see what protective equipment is necessary?
- ❖ Do you wear the protective equipment recommended on the label?
- ❖ Do you clean and maintain your protective equipment regularly and often?
- ❖ Do you throw away rubber gloves that have only tiny holes in them?

Keep the original container so the label is there!

- ❖ Do you always keep pesticides in the original container instead of old "coke" bottles, milk cartons or other food containers?



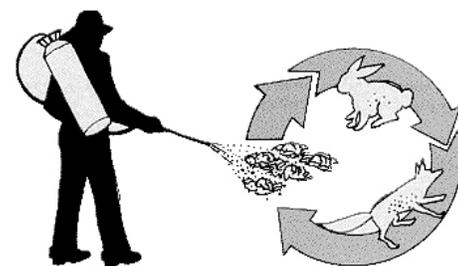
Store pesticides in separate place



Avoid inhaling



Don't smoke, drink, eat during pesticide application



Do your part to aid the environment. Protect your surroundings by practicing proper pesticide use

- ❖ When people ask you for a little spray mix out of your tank do you refuse?
- ❖ Do you always remember what is in an unlabeled container?
- ❖ Do you always remember the safety precautions, antidotes and directions for use, even though the container is not labeled?
- ❖ Do you safely dispose of unlabeled pesticides, rather than take a chance with your memory?

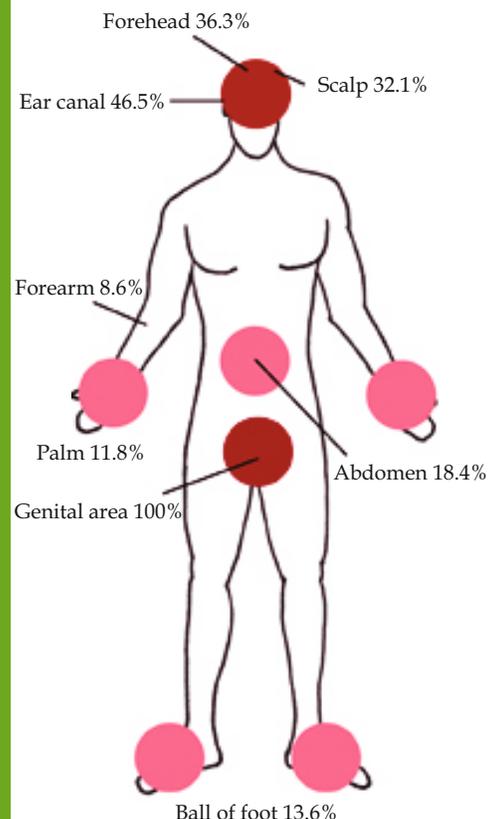
Spills and splashes of concentrates can be very hazardous!

- ❖ Do you know what to do if you should spill a pesticide on yourself while mixing?
- ❖ Do you wear adequate footgear with your pant cuffs on the outside, so pesticides won't run into your footgear?
- ❖ Do you have sawdust, vermiculite, kitty litter or some other absorbent on hand to soak up spills?
- ❖ Do you always watch your sprayer tank when filling so it won't run over and spill on the ground?
- ❖ Do you have a check valve or other device on your equipment to prevent back-siphoning into the water supply?
- ❖ Is your application equipment well maintained so it doesn't leak and leave toxic puddles or piles of pesticide on the ground?
- ❖ Do you avoid draining leftover spray mix on the ground?
- ❖ Do you discard old high pressure hose instead of patching it and hoping no one will be nearby when it bursts?
- ❖ Do you clean nozzles with a brush, by rinsing, etc., instead of blowing them out with your mouth?

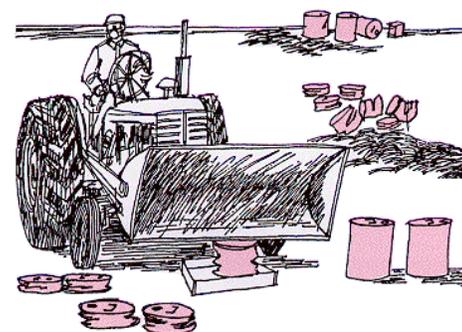
Poor container disposal may cause bad accidents!

- ❖ Do you rinse each "empty" liquid container at least three times and dump the rinse water into the tank?
- ❖ Do you keep your used containers in your storage area until disposal?
- ❖ Do you collect every container for disposal before leaving a job, instead of leaving them in the field or at your tank filling station?
- ❖ Do you puncture, break or crush nonburnable containers so that they can't be reused?
- ❖ Do you keep or return to the manufacturer 30 and 55 gallon pesticide drums, rather than giving them away for floats, trash barrels, etc.?

Protect your HOT spots



Percentages indicate relative amount of absorption of pesticide over a 24-hour period. (Feldman and Maibach, 1974. Percutaneous penetration of some pesticide and herbicides in man. *Toxicology and Applied Pharmacology* 28, pp. 399-404)

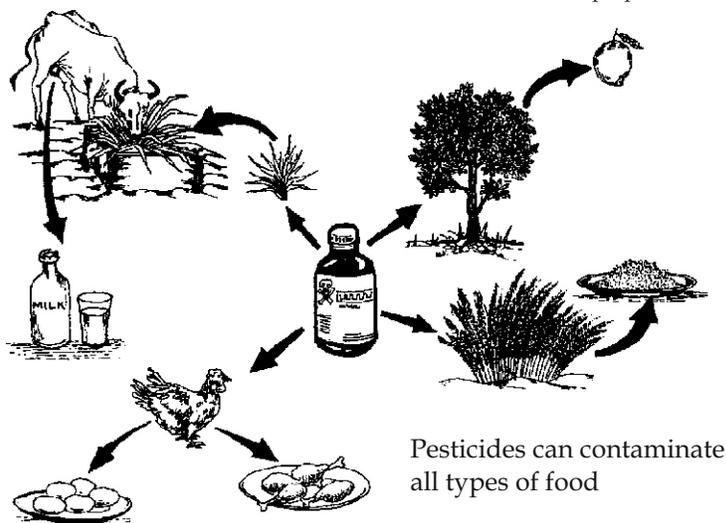


Take the extra time and effort to dispose off surplus pesticides and empty containers properly in licensed facilities. It is well worth your effort!

Care in application prevents accidents

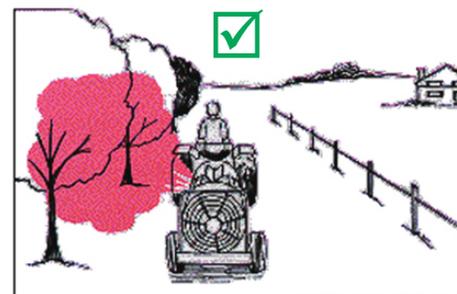
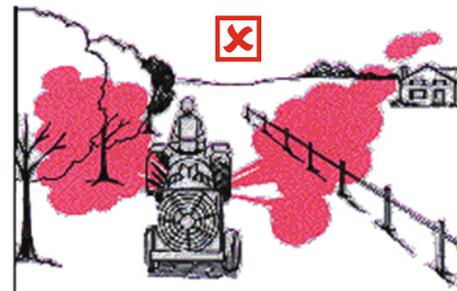
- ❖ Do you check the wind direction and the area downwind before applying pesticides?
- ❖ Do you consider substituting a safer chemical if you are spraying near a sensitive area?
- ❖ Do you check for the possibility of showers and damaging runoff before applying pesticides?
- ❖ Do you plan your pesticide application so it will have little or no effect on bees, birds, fish or other wildlife?
- ❖ Do you remove, turn over or cover up pet dishes, sand boxes, plastic pools, etc., before spraying a private property?
- ❖ Do you make sure that children and pets are out of the area and stay out until the spray dries?

Source : www.psep.cce.cornell.edu

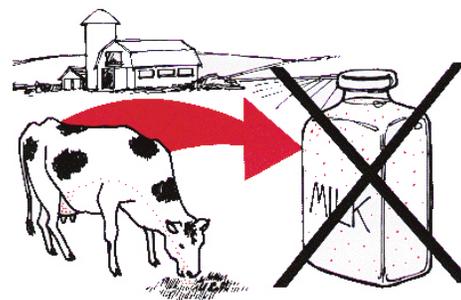


Conclusion

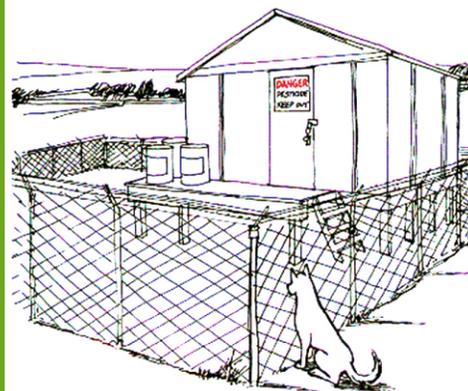
The excess consumption of pesticides contributes in the accumulation of pesticide residues in food grains and vegetables associated with variety of human health hazards, including damage to central and peripheral nervous systems, cancer, allergies and hypersensitivities, reproductive disorders, and disruption of the immune system. The impact of pesticide residues can be minimized by preventive measures such as rational use of pesticides, practising organic farming with good agricultural practices, administering safe handling and use of pesticide guidelines, washing and proper processing of food products, use of natural pesticides and biopesticides, and strict implementation and amendment of pesticide-related laws.



All pesticides can be hazardous.
Use caution whenever you handle them!



Follow waiting period for livestock feed to avoid residues



Take care of pets

Image courtesy:



Cornell University
Cooperative Extension

Recent updates on pesticides in India

I. Pesticides / Formulations banned in India (as on 31.10.2019)

Pesticides banned for manufacture, import and use			
1	Aldicarb	21	Heptachlor
2	Aldrin	22	Lindane (Gamma-HCH)
3	Benzene Hexachloride	23	Linuron
4	Benomyl	24	Maleic Hydrazide
5	Calcium Cyanide	25	Menazon
6	Carbaryl	26	Methoxy Ethyl Mercury Chloride
7	Chlorbenzilate	27	Methyl Parathion
8	Chlordane	28	Metoxuron
9	Chlorofenvinphos	29	Nitrofen
10	Copper Acetoarsenite	30	Paraquat Dimethyl Sulphate
11	Diazinon	31	Pentachloro Nitrobenzene
12	Dibromochloropropane (DBCP)	32	Pentachlorophenol
13	Dieldrin	33	Phenyl Mercury Acetate
14	Endosulfron	34	Sodium Cyanide
15	Endrin	35	Sodium Methane Arsonate
16	Ethyl Mercury Chloride	36	Tetradifon
17	Ethyl Parathion	37	Thiometon
18	Ethylene Dibromide (EDB)	38	Toxaphene (Camphechlor)
19	Fenarimol	39	Tridemorph
20	Fenthion	40	Trichloro acetic acid (TCA)

Pesticide formulations banned for import, manufacture and use

1. Carbofuron 50% SP , 2. Methomyl 12.5% L, 3. Methomyl 24% formulation, 4. Phosphamidon 85% SL

Pesticide / Pesticide formulations banned for use but continued to manufacture for export

1. Captafol 80% Powder , 2. Nicotin Sulfate

Pesticides Withdrawn

1. Dalapon, 2. Ferbam, 3. Formothion, 4. Nickel Chloride, 5. Paradichlorobenzene (PDCB), 6. Simazine, 7. Sirmate, 8. Warfarin

World's Top 10 Agrochemical Companies

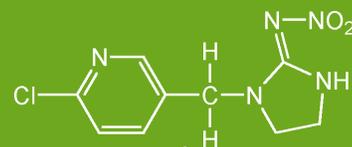
1. Syngenta AG
2. Bayer Crop Science
3. BASF SE
4. Dow Agro Sciences
5. FMC
6. Adama Ltd.
7. Nufarm Ltd.
8. Sumitomo Chemical Co., Ltd.
9. UPL Limited
10. Nutrichem Company Limited



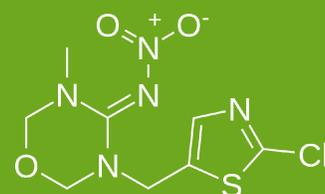
The Indian pesticides market was worth INR 197 Billion in 2018. The market is further projected to reach a value of INR 316 Billion by 2024, growing at a CAGR of 8.1% during 2019-2024.



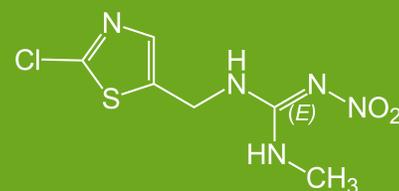
Neonicotinoids (Imidacloprid, Thiamethoxam, Clothianidin) are extremely toxic to bees.



Imidacloprid chemical structure



Thiamethoxam chemical structure



Clothianidin chemical structure

II. Pesticides refused registration

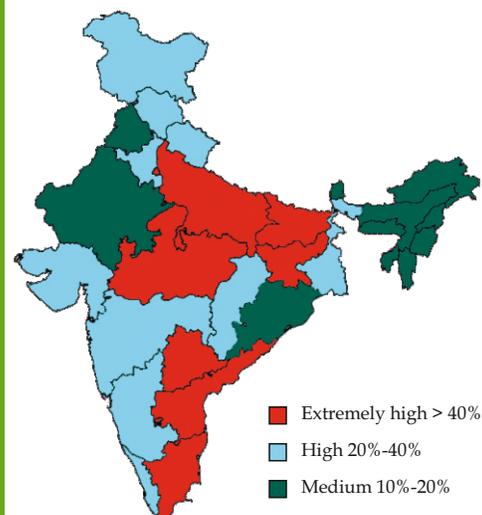
1. 2,4, 5-T, 2. Ammonium Sulphamate, 3. Azinphos Ethyl, 4. Azinphos Methyl, 5. Binapacryl, 6. Calcium Arsenate, 7. Carbophenothion
8. Chinomethionate (Morestan), 9. Dicrotophos, 10. EPN, 11. Fentin Acetate, 12. Fentin Hydroxide, 13. Lead Arsenate, 14. Leptophos (Phosvel), 15. Mephosfolan, 16. Mevinphos (Phosdrin), 17. Thiodemeton / Disulfoton, 18. Vamidotion

III. Pesticides restricted for use in the country

1. Aluminium Phosphide, 2. Captafol, 3. Cypermethrin, 4. Dazomet
5. Dichloro Diphenyl Trichloroethane (DDT), 6. Fenitrothion
7. Methyl Bromide, 8. Monocrotophos, 9. Trifluralin

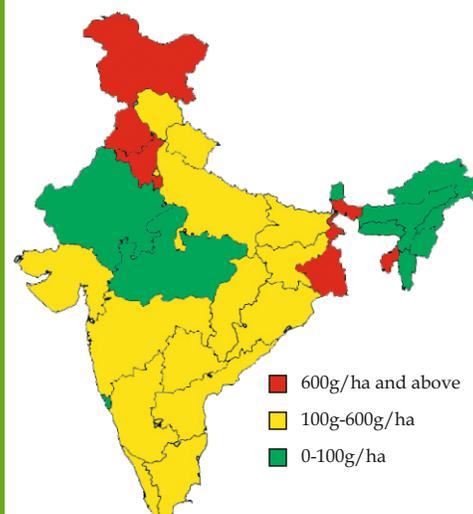
IV. Pesticides which shall be phased out

1. Alachlor, 2. Dichlorovus, 3. Phorate, 4. Phosphamidon, 5. Triazophos, 6. Trichlorfon



States affected by non-genuine pesticides, India-FY14

Source : www.firstpost.com, 2015



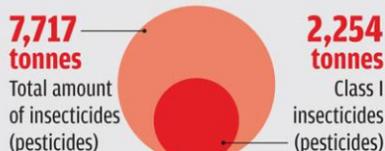
Intensity of pesticide use in different states of India

Source : Indira Devi et al. 2017

Grave danger

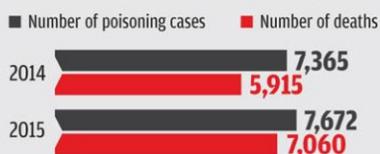
Farmers are in peril due to lack of regulation of hazardous pesticides

Consumption of Class I pesticides in India (2015-16)



Source: Directorate of Plant Protection, Quarantine & Storage. Calculations have been done based on pesticides produced domestically and imported

Cases of accidental intake of pesticides and deaths (other than suicides)



Source: Accidental Deaths & Suicides in India by the National Crime Records Bureau (2015)

Examples of Class I pesticides used extensively in India but banned in other countries

- Banned in countries, including EU*
- Consumption during 2015-16[#] (tonnes)

Monocrotophos



Triazophos



Phosphamidon



Carbofuran



Methyl Parathion



Phorate



Source: *Consolidated list of banned pesticides by Pesticide Action Network (May 2017); [#] Directorate of Plant Protection, Quarantine & Storage

Source : Down To Earth

Pesticides which will be completely banned with effect from December 31, 2020

1. Alachlor
2. Dichlorvos
3. Phorate
4. Phosphamidon
5. Triazophos
6. Trichlorfon

Major uses of pesticides registered under the Insecticides Act, 1968 (as on 31.10.2019)

Crop	Common name of the pest	Dosage/ha			Waiting period (days)
		a.i (gm)	Formulation (gm/ml)	Dilution in water (liter)	
ABAMECTIN 1.9% EC					
Rose (Ornamental)	Red Spider Mites (<i>Tetranychus urticae</i>)	0.00048-0.00096 %	0.025-0.050%	500	3
Grapes	Mites	0.014/L	0.75 ml/L water	500-1000	3
ACEPHATE 75% SP					
Cotton	Jassids	292	390	500-1000	15
	Boll Worms	584	780	500-1000	
Safflower	Aphids	584	780	500-1000	15
Rice	Stem Borer, Leaf Folder, Plant Hoppers, Green Leaf Hopper	500-750	666-1000	300-500	15
ACETAMIPRID 20% SP					
Cotton	Aphids, Jassids	10	50	500-600	15
	Whiteflies	20	100		
Cabbage	Aphids	15	75	500-600	7
Okra	Aphids	15	75	500-600	3
Chilli	Thrips	10-20	50-100	500-600	3
Rice	BPH	10-20	50-100	500-600	7
BIFENTHRIN 10% EC					
Cotton	Bollworm	80	800	500	15
	White Fly				
Rice	Stem borer, leaf folder & Green leaf hopper	50	500	500	21
Sugarcane	Termites	100	1000	500	10 months
BUPROFEZIN 25% SC					
Cotton	White Fly	250	1000	500-750	20
	Aphids, Thrips				
Chilies	Yellow Mite	75-150	300-600	500-750	5
Mango	Hoppers	0.025% to 0.05%	1-2 ml/liter of water	5-15 liter per tree	20
Grapes	Mealy bugs	250-375	1000-1500	500-1000	7
Rice	BPH, GLH, WBPH	200	800	400-500	20
CARTAP HYDROCHLORIDE 75% SG					
Rice	Yellow Stem borer, Leaf folder	318.75-375	425-500	250-500	35-89
CHLORANTRANILIPROLE 18.5% SC					
Rice	Stem borer and leaf folder	30	150	500	47
Cabbage	Diamond back moth	10	50	500	3
Cotton	American bollworm	30	150	500	9
	Spotted bollworm				
	Tobacco caterpillar				
Tomato	Fruit borer	30	150	500	3

Sugarcane	Termite	100-125	500-625	1000	208
	Early shoot borer	75	375	1000	
	Top borer	75	375	1000	
Chilli	Fruit borer	30	150	500	3
Brinjal	Shoot & Fruit borer	40	200	500-750	22
Pigeon pea	Pod borer	30	150	500-750	29
Soybean	Green Semi looper, Stem fly, Girdle beetle	30	150	500-750	22
Bengal gram	Pod borers	25	125	500	11
Black gram	Pod borers	20	100	500	20
Bitter gourd	Fruit borers & Caterpillars	20-25	100-125	500	7
Okra	Fruit Borer	25	125	500	5
CLOTHIANIDIN 50% WDG					
Rice	Brown plant hopper	10-12	20-24	500	12
Cotton	Jassids	15-20	30-40	500	20
	White fly	20-25	40-50	500	20
Cotton (Soil drench)	Jassids, Aphids, Thrips & White Fly	100-125	200-250	1000	76
Sugarcane (Soil drench)	Termite	125	250	1000	310
Tea	Mosquito Bug (<i>Helopeltis theiovora</i>)	60	120	500	5
DIAFENTHIURON 50% WP					
Cotton	Whiteflies, Aphids, Thrips	300	600	500-1000	21
	Jassids				
Cabbage	Diamond Back Moth	300	600	500-750	7
Chilli	Mites	300	600	500-750	3
Brinjal	Whitefly	300	600	500-750	3
Cardamom	Thrips, Capsule borer	400	800	1000	7
Citrus	Mites	1.0 g/l	2.0 g/l	2-3 liter/hect.	30
Cotton	Whiteflies, Aphids, Thrips, Jassids	239	500	500	30
EMAMECTIN BENZOATE 5% SG					
Cotton	Boll worms	9.5-11.0	190-220	500	10
Okra	Fruit & Shoot Borer	6.75-8.5	135-170	500	5
Cabbage	DBM	7.5-10	150-200	500	3
Chilli	Fruit borer, Thrips & Mites	10	200	500	3
Brinjal	Fruit and Shoot borer	10	200	500	3
Red gram	Pod borer	11.0	220	500-750	14
Chickpea	Pod borer	11.0	220	500	14
Grapes	Thrips	11	220	500-1000	5
Tea	Tea loopers	10.0	200	500	1
FIPRONIL 5% SC					
Rice	Stem borer, Brown plant hopper, Green leaf hopper, Rice leaf hopper, Rice gall midge, Whorl maggot, White backed plant hopper	50-75	1000-1500	500	32
Cabbage	Diamond back moth	40-50	800-1000	500	7
Chillies	Thrips, Aphids, Fruit borers	40-50	800-1000	500	7
Sugarcane	Early shoot borer & root borer	75-100	1500-2000	500	9 months

Cotton	Aphid, Jassid, Thrips, White fly	75-100	1500-2000	500	6
	Boll worms	100	2000	500	7
FLUBENDIAMIDE 20% WG					
Rice	Stem borer, Leaf borer	25	125	500	30
Cotton	American bollworm	50	250	500	30
Tomato	Fruit borer	48	100	375-500	5
Cabbage	Diamond back moth	18.24	37.5-50	375-500	7
Tea	Semilooper	30	150	400	7
Chilli	Fruit borer	50 - 60	250-300	500	5
IMIDACLOPRID 17.8% SL					
Cotton	Aphid, Whitefly, Jassid Thrips	20 - 25	100 - 125	500 - 700	40
Paddy	BPH, WBPH, GLH	20 - 25	100 - 125	500 - 700	40
Chilly	Jassid, Aphid, Thrips	25 - 50	125-250	500-700	40
Sugarcane	Termite	70	350	1875	45
Mango	Hopper	0.4 - 0.8 g/tree	2-4 ml/tree	10 litre	45
Sunflower	Jassid, Thrips, Whitefly	20	100	500	30
Okra	Aphid, Jassid, Thrips	20	100	500	3
Citrus	Leaf miner, psylla	10	50	Depending on size of tree & Protection equipments	15
Groundnut	Aphid , Jassid	20-25	100-125	500	40
Tomato	Whitefly	30-35	150-175	500	3
INDOXACARB 14.5% SC					
Cotton	Bollworm	75	500	600-1000	16
Cabbage	Diamond back moth	30-40	200-266	400-750	7
Chillies	Fruit borer	50-60	333-400	300-600	5
Tomato	Fruit borer	60-75	400-500	300-600	5
Pigeonpea	Pod borer complex	50-60	353-400	500-1000	15
LUFENURON 5.4% EC					
Cabbage	Diamond backmoth	30	600	500	14
Cauliflower	Diamond backmoth	30	600	500	5
Pigeon pea	Pod borer, podfly	30	600	500-1000	65
Cotton	American bollworm	30	600	500-750	48
Black gram	Pod borer	30	600	500	10
Chilli	Fruit borer	30	600	500	5
NOVALURON 10% EC					
Cotton	American Bollworm	100	1000	500-1000	40
Cabbage	Diamond back moth	75	750	500-1000	5
Tomato	Fruit borer	75	750	500-1000	1-3
Chilli	Fruit borer, Tobacco Caterpillar	33.5	375	500	3
Bengal gram	Pod borer	75	750	500	7

PROFENOFOS 50% EC					
Cotton	Bollworm	750-1000	1500-2000	500-1000	15
	Jassids, Aphids, Thrips, Whiteflies	500	1000	500-1000	15
Soybean	Semi looper & Girdle beetle	500	1000	500	40
SPINETORAM 11.7 % SC					
Cotton	Thrips	50	420	500-1000	30
	Tobacco caterpillar	50-56	420-470	500-1000	
	Spotted boll worm	50-56	420-470	500-1000	
Soybean	Tobacco caterpillar	54	450	500-625	30
Chillies	Thrips	56-60	470-500	400-500	7
	Fruit borer	56-60	470-500	400-500	
	Tobacco caterpillar	56-60	470-500	400-500	
SPINOSAD 45.0% SC					
Cotton	American bollworm	75-100	165-220	500	10
Chillies	Fruit borer, Thrips	73	160	500	3
Red gram	Pod borer	56-73	125-162	800-1000	47
Brinjal	Fruit & Shoot borer	73-84	162-187	500	03
Grapes	Thrips	25ml/100lit	250	1000	15
SPIROMESIFEN 22.9% SC					
Brinjal	Red spider mite	96	400	500	5
Cotton	White fly & mite	144	600	500	10
Apple	European Red Mite & Red Spider mite	72 (0.03%)	300	1000	30
Chilli	Chilli Yellow Mite	96	400	500 -750	7
Tea	Red Spider mite	96	400	400	7
Okra	Red spider mite	96-120	400-500	500	3
Tomato	Whiteflies & Mites	150	625	500	3
Cotton	White fly & mite	144	600	500	10
THIACLOPRID 21.7% SC					
Cotton	Aphid, Thrips, Jassid	24 - 30	100 - 125	500	52
	Whitefly	120 - 144	500 - 600	500	52
Paddy	Stem borer	120	500	500	30
Chilli	Thrips	54-72	225-300	500	5
Tea	Mosquito bug	90	375	400	7
Brinjal	Shoot & fruit borer	180	750	500	5
Soybean	Girdle beetle	180	750	500	17
THIAMETHOXAM 25% WG					
Okra	Jassid, Aphid, White flies	25	100	500-1000	5
Mango	Hoppers	25	100	1000	30
Wheat	Aphid	12.5	50	500	21
Mustard	Aphid	12.5-25.0	50-100	500-1000	21
Tomato	White flies	50	200	500	5
Brinjal	White flies	50	200	500	3
Tea	Mosquito bug	25	100	400-500	7
Potato	Aphids				
	-Foliar application	25	100	500	77
	-Soil drench	50	200	400-500	77

Source : www.ppps.gov.in

Directorate of Plant Protection, Quarantine & Storage, Government of India

Safe use of pesticides

Before buying pesticides, you must answer the following questions:

- Which pest is to be controlled?
- How much damage has the pest done?
- Are sufficient predators already in the field or are they likely to be there soon?
- What are the recommended pesticides for the pest problem?
- Which is the least toxic and least persistent among the recommended pesticides?
- Note: Buy pesticides from a reputable and reliable licensed store

While buying pesticides

- Do not buy in bulk, buy only as much as you expect to use within a short period
- Do not buy if the container is rusted, torn, leaking, or if the date of use has expired
- Buy only pesticides in their original package with proper labelling
- Buy only pesticides with the ISI mark
- Do not buy banned, restricted, or highly toxic pesticides
- Use pesticides only as a last resort and as part of an integrated pest management strategy. See Integrated pest management

While transportation

- Avoid carrying pesticides on public transport
- Do not transport pesticides together with food products, fodder, or other commodities
- Make sure that pesticides are adequately packaged and do not spill or leak out
- If the pesticide spills or leaks, wash the vehicle with bleaching lime paste (1 kg of lime for every 4 litres of water)

While storage

- Do not keep pesticides in the kitchen or living room. Keep them away from food, animal feed and fodder, and containers of potable water
- Keep pesticides locked away and ensure that they are out of reach of children and pets
- Preferably, store pesticides in a separate room which is well-ventilated and is away from sunlight, fire, and water
- Be careful of cross-contamination. Store herbicides separately from other kinds of pesticides
- Do not keep medicines for humans and livestock together with pesticides
- Reseal containers after partial use

During application of pesticides

- Do not work alone while handling or applying pesticides
- Never allow children, animals, or unauthorized people near the site of mixing and application
- Always use a long wooden stick for mixing pesticides in water
- Spray early in the morning or in the evening. Suspend spraying during midday in summer months
- Avoid excessive spraying. The spray should not drip onto the soil
- Read the label and the instructions carefully before opening the pesticide packet or bottle
- While mixing, pour the liquids carefully to prevent splashing
- Prevent powdered pesticides from blowing into your face
- Never eat, drink or smoke while mixing or applying pesticides
- Wear separate protective clothing and wash these clothes immediately after use
- Avoid application of pesticides on rainy or cloudy days
- Never blow out clogged nozzles or hoses with your mouth. Use a fine wire or pin
- Check the wind direction before starting to spray to avoid drift and do not spray in strong wind
- Mix pesticides only in the field where you will spray. This will reduce the risk of spillage. Never mix pesticides inside your house

After application

- Immediately after spraying, take a bath and change your clothes
- All clothes must be washed immediately after spraying. Wash them separately from other clothes
- Never leave pesticide in sprayers and dusters. Clean equipment with soap, detergent, or soda solution and fresh water
- Dispose of all empty pesticide containers by burning or burying them in the field. Do not use them to store food, water, or as cooking utensils. Do not sell empty containers to hawkers because they might end up being misused
- Return unused pesticide to the storage place and keep it under lock and key
- Do not go into a treated field until the recommended safety period has passed. Read the pesticide label or ask your extension agent about safe waiting periods

The environment and the economy are really both two sides of the same coin. If we cannot sustain the environment we cannot sustain ourselves.

- Wangari Maathai



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