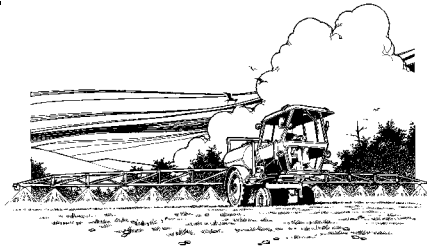


# Pesticides



**Biology**

Science

Grade 10-12

Biology Classroom

Individual Reading

## DESCRIPTION

Pesticides are used extensively to control pests, which can harm crops and other plant species. There are many different types of pesticides. They are mostly synthetic chemicals designed to affect a specific target. Concern over pesticide use is a major issue among many organizations. This article describes pesticides, why they are used, and why they generate so much concern.

## LEARNING OUTCOMES

Students will:

- examine the impact of pesticides on the environment, the economy, and the health and well-being of society
- recognize the significant role of synthetic chemicals in today's agriculture
- identify how public concern for the environment affects agriculture

## READINESS ACTIVITIES

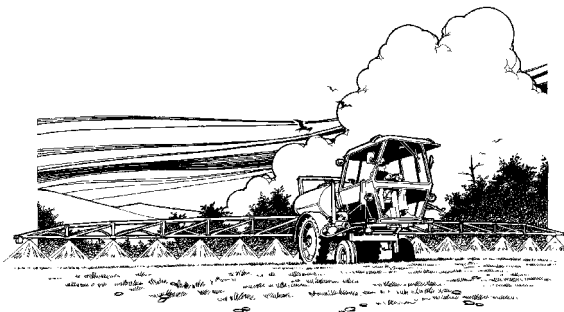
Students should:

- read some recent newspaper or magazine articles for updates on the pesticide issue
- see if there are any types of pesticides around their own homes and what they are used for

## MATERIALS

- Copy of article

# Pesticides



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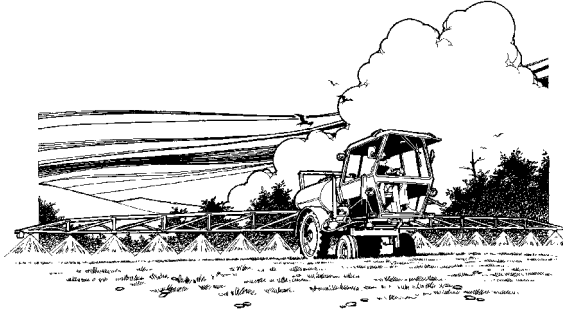
## Introduction

There are many plants and animals which co-exist with crops in a farmers field. Less than one percent of these plants and animals are **pests**. Pests are organisms which attack crops and harm them in some way. It is critical that these pests are controlled for a farm to earn the best income. The use of synthetic **pesticides** in agriculture world-wide is still the most widespread method for pest control. Farmers could not achieve the same yields without the use of synthetic pesticides. It is estimated that without them 30% of world crops would be destroyed by harmful organisms such as insects, weeds, or plant diseases even before they were harvested. Pesticides prevent these loses by controlling such pests. Pests can also render food unfit for consumption, harm human health and also harm the environment. In crops like cotton, tomatoes or melons, difficulties in pest control have forced farmers in some countries to abandon these crops completely.

## Pesticides

Chemical control is the use of pesticides to reduce pest populations. The three major pesticide categories are **herbicides**, **insecticides**, and **fungicides**. Herbicides are chemicals that are used to control weeds, insecticides are chemicals used to control insects and fungicides are chemicals used to control plant diseases caused by fungi. There are many different types of these pesticides which affect pests in many different ways. Within each pesticide group are numerous chemicals for use in specific applications. Depending on the chemical structure, the pesticide may interfere with the growth, reproduction or development of the pest or may induce damage to the internal systems, resulting in death. Some pesticides are more popular than others for reasons such as potency, availability, cost, and safety. There are usually a few brand names of pesticides which dominate the market. It is important to remember that no pesticides kill 100% of the pests all the time. They simply kill enough pests so that the few remaining are no longer a problem. Most pesticides commonly used for agricultural, home and garden use belong to chemical families that are not toxic to humans or animals, do not pose cancer risk to humans and do not accumulate in the environment.

# Pesticides

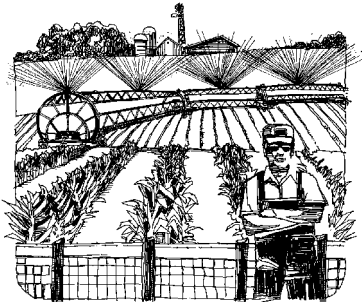


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## Application

When farmers spray pesticides, they try to distribute a small amount of active ingredient to the appropriate biological target without contaminating other areas. There are many different types of targets for pesticides. These include insects, plants, or soil. A variety of application techniques are required to affect these targets while using as little pesticide as possible. The equipment used for pesticide application ranges in price and complexity. Some application techniques include:

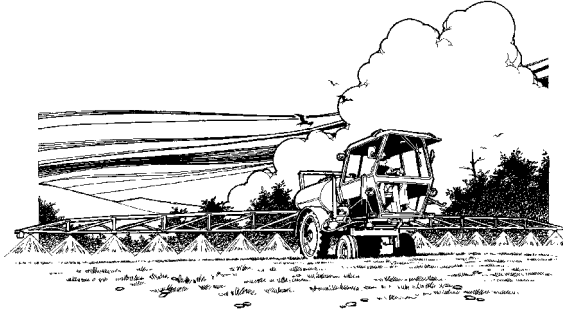


- release from the air in the solid state as dusts or granules or in the liquid state as sprays
- injection into the plant
- injection into the soil
- release into water which is then used for **irrigation**
- release from aircrafts when the areas to be treated are large and when operations on the ground are either not possible or will cause damage

## Not Just on the Farm

Pesticides are more widely known for their use on farms to protect crops. Chemicals are used by people everyday to get rid of pests. Remember the last time you used Raid or Off? Pesticides are used mostly to control insects, in homes, office buildings, schools, hospitals, supermarkets, and many other common areas. Most of these products are in the form of aerosols, pest strips, baits, pet products, and insect repellents. Pesticides are also used on lawns, gardens, golf courses, parks, and recreational areas.

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## Pesticide Safety

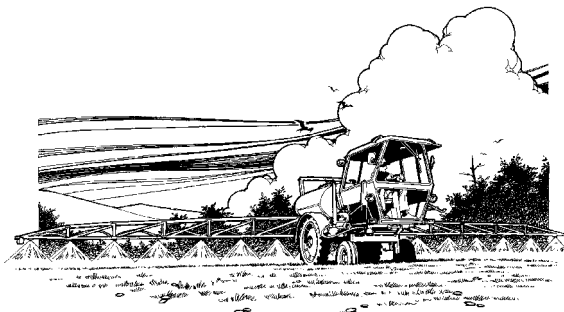
Because pesticides can kill pests, they also pose a potential risk to other organisms such as humans. For this reason, they are not allowed to be used without the most thorough checks and safeguards to ensure that they do not harm humans, other species, or the environment. Because of the concerns, synthetic pesticides have undergone a development process to match with today's requirements. They have become less toxic for humans, they have become more specific, and they have become more powerful. For example, 40 years ago pesticides were applied in kilograms or litres of active ingredients per hectare. Modern pesticides only require grams or millilitres to achieve the same or better results. Remember that pesticide residues remain only on the surface of produce. Rinsing with clear water will remove most of any trace residues.

## Pesticide Problems

There are various problems which can occur when using synthetic chemicals to control pests. Some pests can build up **resistance** to pesticides. Pesticide resistance is the ability of an organism to tolerate a lethal level of a pesticide. This results in larger applications and a reduction in the effectiveness of the pesticide. Many of the chemicals used are not selective. They may also kill beneficial species, such as bees which pollinate crops. Synthetic chemicals may end up hurting the plant the farmer is trying to preserve. Environmental pollution is another problem as pesticides may build up in the soil or run off in the water supply. Pest **resurgence** may also occur. Pest resurgence occurs when a pest population level can establish itself after control measures against the population have been eliminated or reduced.



# Pesticides



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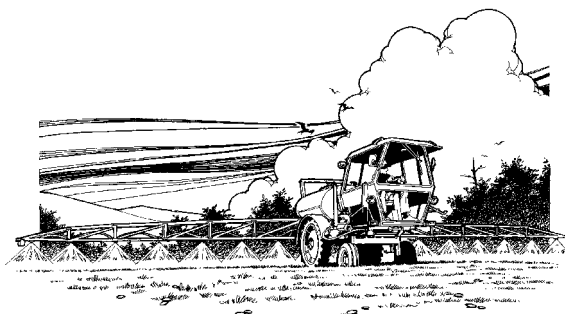
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In some countries other than Canada, the irrational use of pesticides and equipment has led to serious problems. In some crops, the costs of pesticide use are already higher than the benefits. While modern pesticides have reached the most remote parts of the world, the application equipment matches that which existed 40 years ago. This has resulted in large wastes of pesticides and unnecessary environmental contamination. Farmers and application equipment operator's knowledge of pesticides and the correct method of application is usually deficient or non-existent. In many cases they do not receive any training on the issue. Sometimes, the only specialists are representatives of pesticide companies. Of course it would be a poor business move for them to show farmers how to save money by using less of their product. Some farmers and spray equipment operators still believe that the more pesticides you use, the better. The lack of technical knowledge and awareness of farmers and manufacturers are the main reasons for the low quality of equipment found in some countries. There are also many cases of poor equipment maintenance. Many products which are considered to be highly or even extremely toxic and can lead to a considerable amount of poisoning are still used in some countries.

## Pollutant

After a pesticide is applied not all of the pesticide remains where it is needed. When a pesticide leaves the target area, it is often considered to be an environmental **pollutant**. Movement of pesticides can occur in several ways. Drift, soil leaching, run-off, improper disposal and storage, and improper application are some of the major causes. Pesticide drift is a major cause of soil and air contamination. Drift occurs at the time of pesticide application when small spray particles are moved by air currents to nontargeted areas. Most of these sources of contamination can be avoided with proper care and handling on the part of the farmer.

# Pesticides



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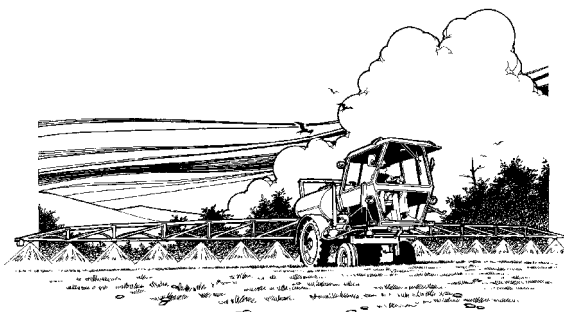
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## New technology

Pressure for the use of pesticides in a manner that is safer for environment and humans has led to new approaches to pest control. Modern application equipment allows a fairly safe and efficient application of pesticides of all kinds. Legal requirements and farmer's demands have forced equipment manufacturers in Europe to offer only state of the art machinery. The equipment is designed to help prevent unnecessary contamination, accidents, losses and spills. The use of modern electronics has improved the accuracy of pesticide spraying. The Global Positioning Systems (GPS) for precise tracking has improved the safety of aerial pesticide spraying. GPS technology also allows patch spraying against certain weeds. If a weed is detected by the GPS system, the nozzle on the sprayer is opened only at that point. Therefore, lower amounts of pesticides are used. The entire field does not need to be dosed, which saves money for the farmer.

## Alternatives

Non chemical alternatives for pest control have existed for quite some time. Some non-chemical alternatives include cultural practices such as **crop rotation**, choice of resistant plant varieties and use of biological products and agents. The concept of pest management, where synthetic pesticides are only applied as a last resort, is now considered common practice in professional agriculture. The development of plants with built-in pest resistance is a valuable alternative. This can be done by selecting plants with pest resistance, by **crossbreeding** a crop plant and a plant with a desirable characteristic, or by using plant **biotechnology**. However, some of these new developments have also encountered significant opposition.



## Biological Control

**Biological control** uses natural agents such as predators, parasites, and pathogens to control pests. The natural enemy of an insect can be introduced to the crop. For example, the aphid is a pest which eats many crops. Lady bugs eat aphids. Animals such as this which control pests and help a crop are called **beneficial species**. There can be some problems with this method. It might take more time than is needed for the farmer to save his crop, it may not be affordable, and it is sometimes hard to predict if the beneficial species will have other adverse effects on the environment. Biological control requires a thorough understanding of the biology and ecology of the beneficial organism, as well as the pest.

## Organic Farming

Organic farming involves growing crops without applying synthetic fertilizers, herbicides, or pesticides. Only natural products, such as composted manure, are used to improve soil quality. Many natural products are used to control pest populations. For example, insecticidal soaps and oils are effective at controlling many different insects. These soaps and oils are non toxic to humans and pets. Botanical pesticides are derived from raw plant materials like flowers, roots, and stems. They are also safe to humans. Both types of chemicals can damage plants and kill beneficial organisms if care is not taken in their use. Here are two recipes for making these chemicals:

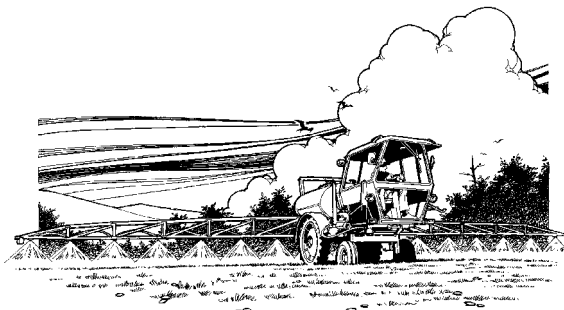
### SOAP and OIL

1 Tbsp liquid dish soap  
1 cup oil (peanut, corn,  
soybean, or sunflower)  
1 cup water

### GARLIC OIL

½ cup minced garlic  
2 tsp mineral oil  
1200 ml water  
1 tsp liquid dish soap

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Organic agriculture appears to be gaining acceptance on Prince Edward Island. There are more than 30 certified organic growers on the Island. More than 1,000 acres of land are currently being used to grow crops such as apples, blueberries, vegetables, herbs, soybeans, potatoes, hay, buckwheat and grain.



## Natural Food Substances

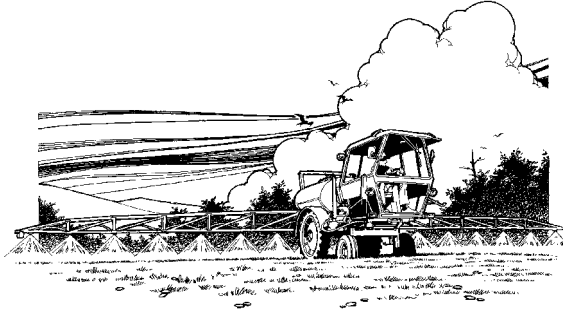
Many people are alarmed by the addition of man-made products, including small amounts of regulated pesticide residues, to their food. These people may be alarmed to find out that many substances which occur naturally in food can be just as harmful. Food-borne disease easily affects the most people. Usually this is due to the way food is handled or stored. Over consumption, poor food choices and less than desirable intake of many essential ingredients is also a major problem. Natural toxins in foods can be a problem when a person's diet is poor. Hazards from pesticide residues or food additives are only a minor problem when it comes to harmful foods. Most people would view these hazards virtually in reverse order of importance. Chemicals used as pesticides are popularly considered the key threat to food safety by many. Lack of education on the subject and media propaganda are responsible for this.

## Carcinogens

The residues of a few pesticides used on food crops can pose potential health problems by acting as carcinogens. A carcinogen is a material capable of causing cancer. Some recent studies seem to indicate that many natural compounds in food may pose greater cancer risks than man-made carcinogens. People should rest assured that the actual cancer risk from both natural and man-made compounds is minutely small. All of the food which we eat is tested very carefully. Simply eating a balanced diet that includes most fruit and vegetables is actually a good way to fend off cancer.



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## Pesticides in Canada

Canada's pesticide regulatory system is one of the most stringent in the world. The Food and Drugs Act in this country limits pesticide residues in foods to no more than 0.1 parts per million. Each year, the federal government tests thousands of fruit and vegetable samples to ensure maximum residue limits are not exceeded. Any imported produce must meet the same standards. Responsibility for pesticide regulations is administered by Health Canada. Before being registered for use, all pesticides are approved by the Pest Management Regulatory Agency under Health Canada. Pesticide use in Canada is lower than most countries. Canada uses less than one twentieth of what is used in the Netherlands, a fifth of what is used in France and less than half of what is used in the United States.



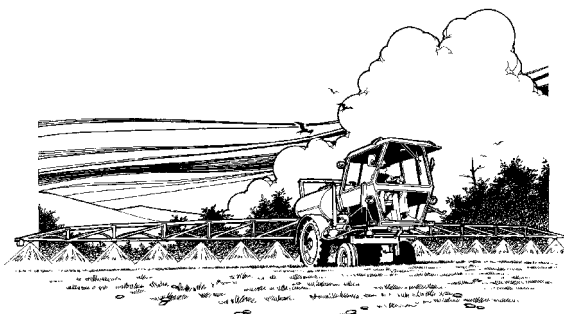
## Local Concerns

There is a growing concern about the known and unknown consequences of pesticides on environment and human health. This has led to a strong public pressure to reduce their use. Some farmers on Prince Edward Island have already encountered this pressure. In 1996, some residents who live along the Mason Road in Stratford complained that drift from the spraying of nearby potato fields was making them ill. A study by the Provincial Health Officer found no relation between pesticide sprays and the symptoms experienced by these residents.



During the summer of 1997, the Town of Stratford presented its official plan to the provincial Attorney General. It called for a ban on "intensive agriculture" practices in the town's residential zone. This would put an end to potato farming in Stratford. After consulting with the town and agriculture groups, the Attorney General signed the plan in July. As of August 1997, the term "intensive agriculture" was still in the process of being clearly defined.

# Pesticides



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Many farmers around the Island are concerned about the precedent that Stratford is attempting to set. The general sentiment is that if the ban is allowed in Stratford, what will stop other communities from following the same example.

## Education is the Key

The lack of knowledge at all levels has been identified as the main reason for deficiencies in pesticide application practice. Because of the Pesticide Act on Prince Edward Island, farm owners and managers are required to be licensed as pesticide applicators. Practical training of farmers and equipment operators has been introduced. Continuing education will provide the technical knowledge necessary for a safe and efficient application by the industry. The public also needs to become educated about the benefits and drawbacks of pesticide use. This would allow them to form their own opinions instead of being influenced by what they hear on television or read in the news.

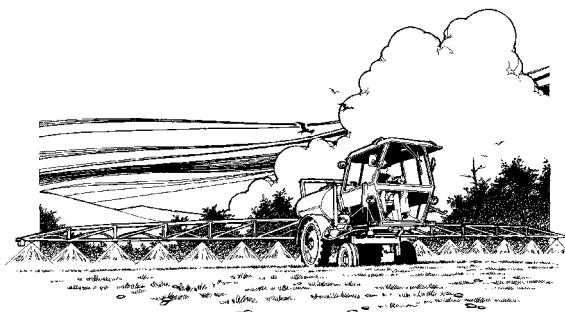
## Activity

Organize a debate in your classroom. Use one group to explain the benefits of pesticide use and another to explain the drawbacks. Review any current headlines involving pesticide use. Do any of these stories have an impact on your community? Do you know any of the people associated with one view or the other? There are many other issues involved other than those presented in this article.

## Glossary of Terms

<b>beneficial species</b>	an organism which can control pests and is helpful to a crop
<b>biological control</b>	pest control that uses natural control agents
<b>biotechnology</b>	use of cells or components of cells to produce other products
<b>crop rotation</b>	planting of different crops in a given field every year or every several years
<b>crossbreeding</b>	is the breeding of one recognized breed of animals or plant species to another recognized breed or species

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<b>fungicides</b>	a material used to destroy and protect against fungi
<b>herbicides</b>	a substance for killing weeds
<b>insecticides</b>	a material used to kill insects or protect against their attack
<b>irrigation</b>	addition of water to plants to supplement that provided by rain or snow
<b>pesticides</b>	chemicals used to control pests
<b>pest</b>	any organism that adversely affects man's activities
<b>pollutant</b>	a substance containing harmful chemicals or organisms
<b>resistance</b>	the ability of an organism to develop protection against harmful substances
<b>resurgence</b>	the ability of an organism to re-establish itself after suffering great losses

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