# Pesticide's Impact on Horticulture: Advantages and Disadvantages

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## Introduction

In the process of agricultural development, the pesticide has become important for an increase in production. Further, pesticides play an important role in keeping many diseases away. The world population is increasing rapidly and to meet world food requirements there is a need to increase food production and productivity. India is the second-largest horticultural producer in the world with 334.60 Million Tonne horticultural production, and producing 12 percent of global fruits and vegetables in 2020-21 (https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1810624). The major strategies to increase productivity are to control crop diseases and proper management of insect pests because more than 45% of annually crop produce was lost. The countries like India where tropical climatic condition is there, crop losses due to insect pests as high as Rs. US$ 42.66 million in annual production, because of high temperature and humidity providing favorable conditions to grow and multiply insect- pests (Subash et al., 2017). Thus, a wide variety of pesticide applications on crops is required to control various diseases, but pesticide residue fount in soil, water, and air. It harms humans, animals, birds, plants, beneficial organisms, aquatic ecosystems, and targeted and non-targeted vegetation and wildlife.

## Pesticide production and use in India

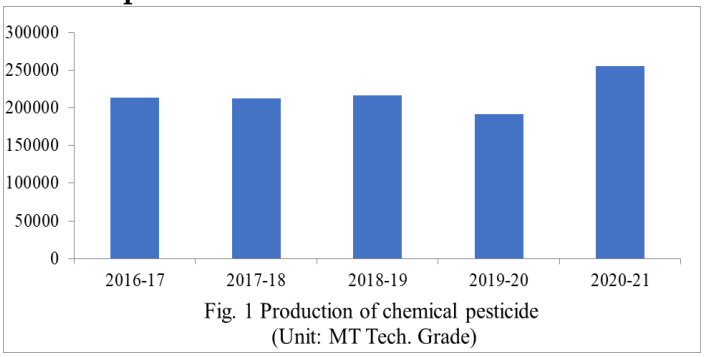


**Fig. 1. Source: http://ppqs.gov.in/statistical-database**

There is more than a thousand pesticide mainly two types, chemical and biological nature available in the market. There has been a steady growth in the production of technical grade pesticides in India (fig. 1) and, the use of chemical biopesticides follows (fig. 2) an increasing trend. The area under non-chemical pesticide application is decreasing (fig. 3).

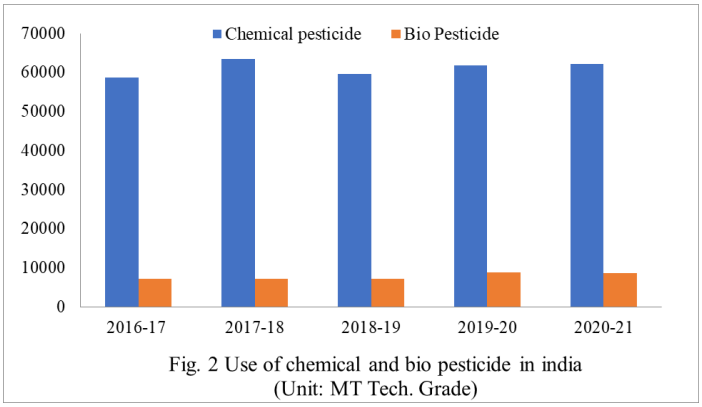


**Fig. 2. Source: http://ppqs.gov.in/statistical-database**

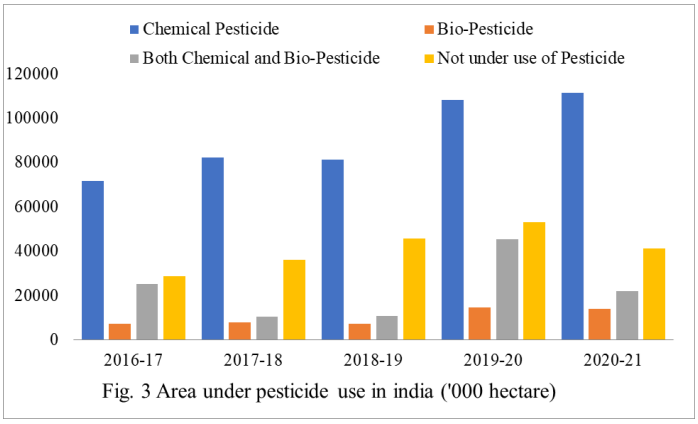


**Fig. 3. Source: http://ppqs.gov.in/statistical-database**

**Pesticides' advantages:** The use of pesticides helps to produce more with less land and remove hand weeding operations.

**a) Increased production:** The increase the productivity and production by application of advanced technology, better variety, and better management practice, but control of insect pests, weeds, and diseases by the application of pesticides is an integral part of the crop production system. The application of pesticides is a major common practice to control insect pests in agriculture and it helps to increase productivity by between 10 to 50 % and production. It helps in conserving the environment by using less energy in crop management and cultivation.

**b) Crop loss/yield decrease protection:** Weeds are the major biotic stress which affects crop production due to crop weed competition. In the early stage of crop

growth, weeds have severe competition and it will lead to major crop/yield loss, for example, in the rice crop production system, due to weeds 33% of total yield losses (Saha et al., 2018). The application of herbicide at the proper time saves crops from loss and also saves cost and energy spent on weed management.

**c) Vector disease management**

Illness and death are the major cause of victor borne diseases in tropical and subtropical countries. Vector control by, an application of pesticide/insecticide play important role in tackling the diseases like malaria, dengue, and filariasis (Rivero et al., 2010). Pesticides are used to control vector-borne diseases for the last 70 years (WHO, 2006).

**d) Food quality**

The use of pesticides increases the productivity and quality of fruits and vegetables, and these crops have very less amount of chemical residue. As we know eating fresh fruits and vegetables reduces the risk of many diseases like high blood pressure, cancers, diabetes, stroke, and another chronic disease (Aktar et al., 2009).

**e) Other areas such as transportation, sports complexes, and construction**

To prevent seeds and grain from insects and fungicide pesticide is used and also for storage. While transporting and preserving the wooden material from termites and wood boring insect pesticides are being used. The use of pesticide/herbicide to prevent sports complexes, construction sites, and roadside areas free from unwanted bushes and weeds.

**Pesticide hazards**

**a) Direct human impact**

Pesticide poising is a major global problem and around 300000 deaths happen every year (Sabarwal et al., 2018). The human body comes in contact with pesticides (which exist in an ecosystem such as soil, water, air, and food) by skin, breathing/ inspiration, and swallowing. Pesticide exposure causes chronic diseases such as kidney failure, affecting the functioning of the immune system, hormonal imbalance, sterility, neurological and behavioral disorders, and cancer. The severity of health hazards depends upon the amount of exposure, in moderate health hazards include headache, rashes, itching, flu, and blurred vision. Furthermore, high occupational, accidental, or intentional exposure to pesticides can result in hospitalization and death (Nicolopoulou-Stamati et al., 2016) In India majority of the population is engaged in agriculture and they expose to hazardous chemical pesticides while the application is in the field. The most susceptible group exposed to pesticides is production workers in the factory, row material handling and handling of pesticide for loading and unloading,

**b) Impact through food commodities**

Food demand increasing day by day and the use of pesticide increase in agriculture, particularly in developing countries. The farmers not having training on how to use pesticides may result in a high risk for consumers (Reiler et al., 2015). Pesticide residue is found in various types of everyday foods and beverages, and washing and peeling do not remove its residues (Chourasiya et al., 2015). Human breast milk has also detected pesticide residue and it will cause health effects in children (Damgaard et al., 2006).

**C) Impact on the environment**

The inappropriate application and use of pesticides affect the whole ecosystem by entering the residues in the food chain and polluting the soil, air, vegetation, ground, and surface water. The applications of pesticides to kill insects and weeds directly affect birds, fish, beneficial insects, and nontarget plants.

**d) Surface water contamination**

In surface water, pesticide residue is a major problem to the biological ecosystem and it poses serious health concerns to humans also. There are various ways by which it can be contaminated spraying application and washing of used equipment, pesticides applied to soil, industrial effluent, accidental spillage, and surface runoff rivers, lakes, and ponds (Singh and Mandal, 2013).

**e) Groundwater contamination**

Leaching is the major factor to contaminates groundwater and it causes by rain and irrigation because farmland is provided with drainage channels and water easily flows out of the field. Another the pesticide leaching depends upon how much amount applied solubility, soil, and root holding capacity of the pesticide (Pérez-Lucas et al., 2019). The control of pollution in groundwater is very difficult once toxic

chemicals are contaminated. It will be a very costly and complex process to treat the polluted water.

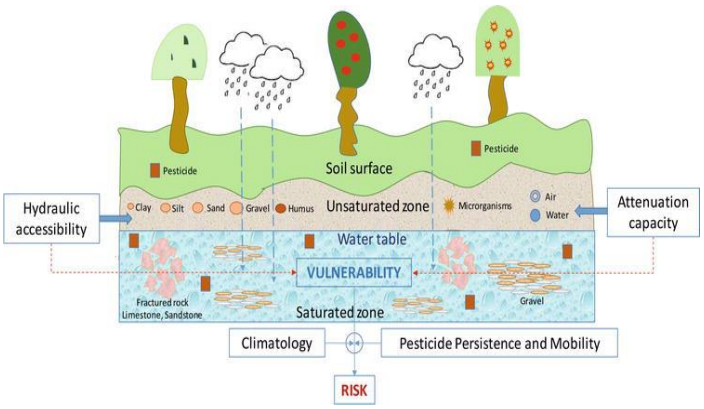


**Fig. 4. Properties and factors affecting groundwater vulnerability (Gabriel Pérez-Lucas et al., 2019)**

**f) Soil contamination**

In crop production system is a major source of pesticide accumulation in soil. It is due to the excessive use of chemicals and pesticides to control insect pests and weeds (Gill et al., 2014). Soil properties and soil micro-flora affect pesticide degradation, transport, and absorption.

**g) Effect on soil fertility (beneficial soil microorganisms)**

The population of beneficial microorganisms decreases due to the heavy use of pesticides to treat the soil. To improve soil fertility earthworms play an important role in soil aeration, decomposing organic matter into humus, and drainage (Paoletti, 1999). The various cultural practices and the use of pesticides application greatly affect the earthworms. The nitrogen-fixing bacteria convert atmospheric nitrogen to nitrate to use by plants. the growth and nitrogen fixation effects due to the use of glyphosate (Santos and Flores, 1995). The use of herbicide can damage mycorrhizal fungi growth which helps in nutrient uptake by plants (Kelley and South, 1978).

**h) Contamination of air, soil, and non-target vegetation**

Biomagnification is the process in which the concentration of pesticide increases in tissues due to its persistence and non-biodegradable nature at each successive level of the food chain. It affects more to the organism at a higher level as compared to a lower level. Pesticide application not only hit the target vegetation but also non-target vegetation, evaporates, and causes air pollution. The loss of pesticide due to drift range from 2 to 25 % and around 80-90 % volatilize within in few days of application (Majewski, 1995).

**i) Non-target organisms**

In biological control, some organisms like predators' prey on other organisms and they are important in controlling pests and their population was decreasing due to excessive pesticide use. Pollination is the main process in agricultural and other vegetation to create offspring/seeds for the next generation. The pesticide application affects pollinators and causes colony mortality and reduces pollen collecting efficiency. Water bodies' contamination affects the aquatic life of fishes, algae, and plants. The non-target birds eat pesticide-treated gains that cause death example pigeons are mainly affected (Aktar *et al.,* 2009).

**Conclusion**

Initially, to benefit human life pesticides are used in the agricultural production system for controlling insect pests, and diseases to increase productivity. But there are several adverse effects of pesticide application like resistance in pest population and a decrease in beneficial organisms. The pesticides enter various food chains and higher tropic levels due to their persistent nature and their effect on humans and other organisms. The use of personal protective equipment and clothing while spraying is lacking by farmers. Proper handling and training should be given by extension workers to horticultural farmers.

Advanced technology is used to develop resistance genotypes with the help of biotechnology and nanotechnology, and also the use of manual and mechanical tools to minimize the use of pesticides/chemicals in horticultural crops. To reduce the negative environmental effect of chemical pesticides there is a need to use bio-pesticide and integrated pest management (IPM); it has the potential to control crop losses. Bio-pesticides have the potential to control crop losses and reduce negative environmental externalities. Bio-pesticides constitute around 3 percent of the pesticide market in the country.

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