Pesticides

Background

A pesticide is any substance used to kill or control the growth and development of insects, plants, fungi, bacteria, rodents, or other unwanted organisms. New Jersey is home to a diverse landscape of agricultural fields, golf courses, housing developments, and other features in close proximity that rely on pesticide use to maintain healthy and productive communities. Pesticides provide a range of benefits to human beings, including increased food production and quality, and reduction of insect-borne disease, but their use also poses possible adverse impacts on the environment. Once released into the environment, pesticides can move through the hydrologic system to streams and ground water where they may inadvertently come into contact with human beings and wildlife. The use of pesticides may affect nearly every New Jersey resident, and this creates a need for balance between the risks and benefits of pesticide use.

Pesticides can be divided into two broad groups: chemical and biological (biopesticides). Historically, chemical pesticides are generally synthetic materials that directly kill or inactivate the pest. Some insecticides, known as organophosphates and carbamates generally work by affecting the nervous system through disruption of acetylcholinesterase, an enzyme that regulates the neurotransmitter acetylcholine. Herbicides kill plants, sometimes selectively, by impairing metabolic and developmental processes unique to plant life. Likewise, fungicides impair the metabolic processes of fungi.

Biopesticides are pesticides derived from naturally occurring materials and fall into three major classes: microbial, plant incorporated protectants (PIPs) and biochemical. Microbial pesticides consist of a microorganism (e.g., a bacterium, fungus, virus or protozoan) as the active ingredient (AI). Many microbial species produce proteins that have pesticidal properties to eliminate or suppress competition for resources or increase their own survivability. PIPs are pesticidal substances that genetically modified plants produce from genetic material that has been added to the plant. For example, scientists can take genes for the insecticidal proteins from *Bacillus thuringiensis* (a microorganism with insecticidal properties) and introduce them into a plant's own genetic material. Then the plant, instead of the *Bacillus* bacterium, manufactures the substance that destroys the pest. Another class of biopesticides include biochemical pesticides, which are naturally occurring substances that control pests by specific, non-toxic mechanisms. This class of pesticides includes substances such as insect sex pheromones that interfere with mating behaviors or scented plant extracts that attract insect pests to traps.

Goals

NJDEP initiatives have been implemented to ensure that those who choose to apply pesticides do so in a safe and proper manner, thereby minimizing pesticide exposure to the public and the environment. A cornerstone of these efforts is Integrated Pest Management (IPM), which is a comprehensive approach to controlling pests that employs methods discouraging or preventing pest invasion through improved sanitation, engineering modifications, and other techniques before resorting to chemical applications. IPM promotes effective pest management while limiting the potential exposure and risk associated with traditional pesticide application. In 2004, regulations were adopted requiring the implementation of IPM practices at public, private and charter schools throughout the state. These measures reduce children's exposure to potentially harmful pesticides and help safeguard public health. These regulations are important because children are more vulnerable and susceptible than adults to the toxic effects of pesticides.[3,4]

Status and Trends

The New Jersey Pesticide Control Program began a series of pesticide use surveys in 1985. These surveys are conducted on a rotating three-year schedule and provide the starting point for both assessing the risk and determining the impact of pesticide use. These surveys are administered to categories of licensed applicators in New Jersey including those involved in agriculture, golf course maintenance, lawn care, mosquito control, right-of-way, and structural pest control (structural data are not included in this trend report due to differences in scale and type of application). Usage data from these sectors are collected and used by programs within the NJDEP, along with other state agencies to aid in research, exposure management and monitoring effects in areas such as ground water protection, farm worker protection and education, and residual pesticide sampling. These data are specific for New Jersey and can identify both the type and area of potential exposures to New Jersey residents. These use surveys also help the NJDEP to quantify the use of high risk (HR) pesticides, and help to identify patterns in use over time. HR pesticides are those which may pose risks to human and environmental health due to the compounds' acute and/or chronic toxicity, or likelihood of entering ground or surface waters.

The included figures summarize pesticide use data collected for the various sectors surveyed. Agricultural pesticide application represents the largest proportion of pesticide use in the state, followed by lawn care and golf course applications (Figure 1). While there are some fluctuations of amounts used from period to period, overall totals in each category have remained consistent over time. Overall HR pesticide use has declined 9%, from 900,000 pounds of HR AI (active ingredient) in the survey period 1999-2002 to 730,000 pounds of HR AI in the survey period 2011-2013 (Figure 2). HR insecticides have shown the greatest decrease, from 152,000 pounds of AI from the 1999-2002 survey period to 88,000 pounds of AI (approximately a 42% decrease) in the 2011-2013 survey period (Figure 3). An increase of HR fungicides during the time period 1999-2001 to 2002-2004 is also noted.

These changes may be a result of emerging pest resistance to HR pesticides and the development and use of new non-HR chemistries and biopesticides with different biochemical mechanisms of action to mitigate pest populations. In addition, changing regulatory practices on both the federal and state levels, and a greater emphasis on IPM practices in the private and public communities, may also play a role.

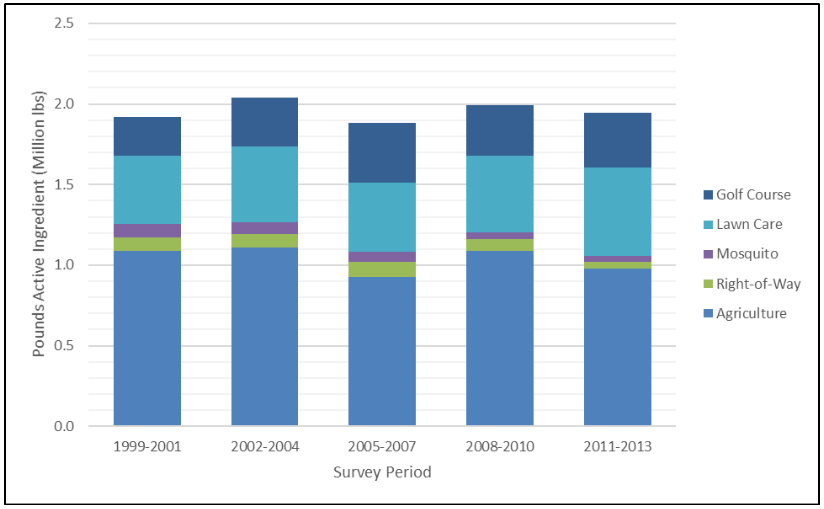

Figure 1. Total statewide pesticide application by survey.

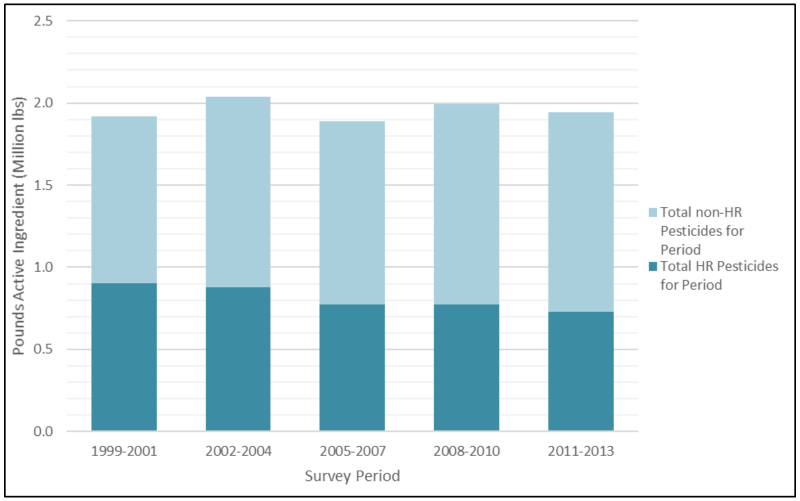

Figure 2. Total statewide pesticide application by high risk (HR) and non-high risk (non-HR) type.

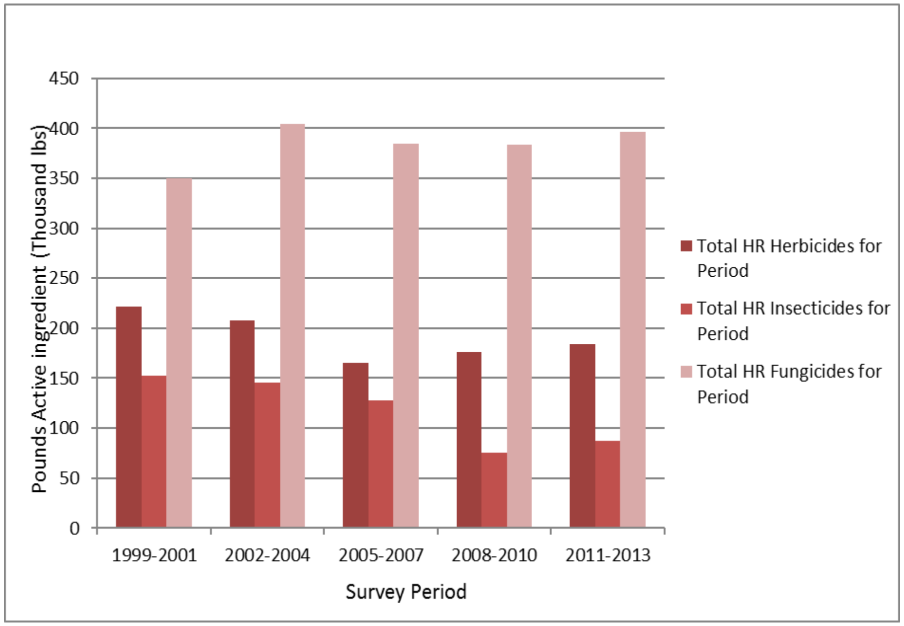

Figure 3. Total high risk (HR) pesticide applications are displayed by type (Herbicide, Insecticide, and Fungicide).

Agricultural use surveys were conducted every third year since 1985. Up until the 1997 survey, pesticide use was fairly consistent, with between 1.4 and 1.8 million pounds of AI applications (Figure 4). During this time, the percentage of HR AI increased from 47% to 62% of the total amount of AI applications recorded. In the following survey years, total AI application never exceeded 1.1 million pounds, and the percentage of HR AI reported was reduced for each subsequent survey, until the most recent record in 2012. Agricultural HR AI application increased from an historic low of 375,000 pounds in 2009 to 420,000 pounds in the most recent 2012 survey. Figure 5 clearly shows a decrease in the amount of HR insecticide application since the beginning of the survey period while HR herbicide and HR fungicide remain fairly constant as a percentage of total AI application over time.

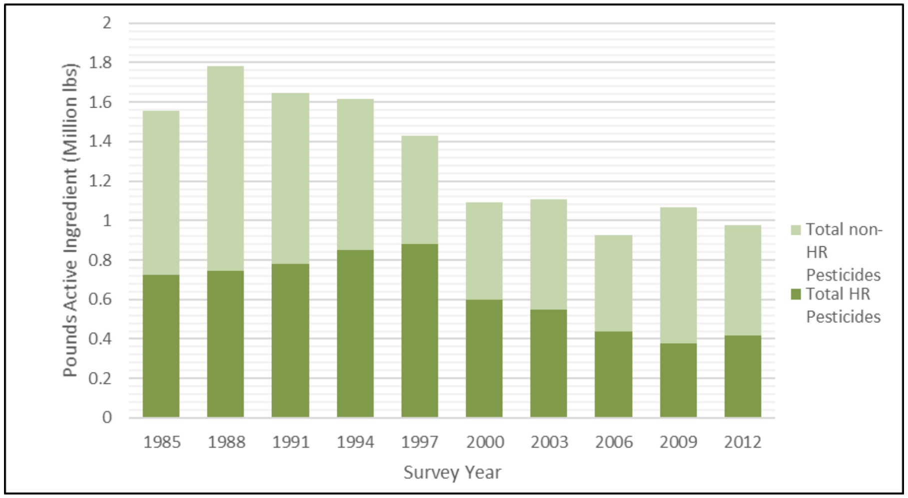

Figure 4. Total agricultural high risk (HR) and non-high risk (non-HR) pesticide application reported by survey since 1985.

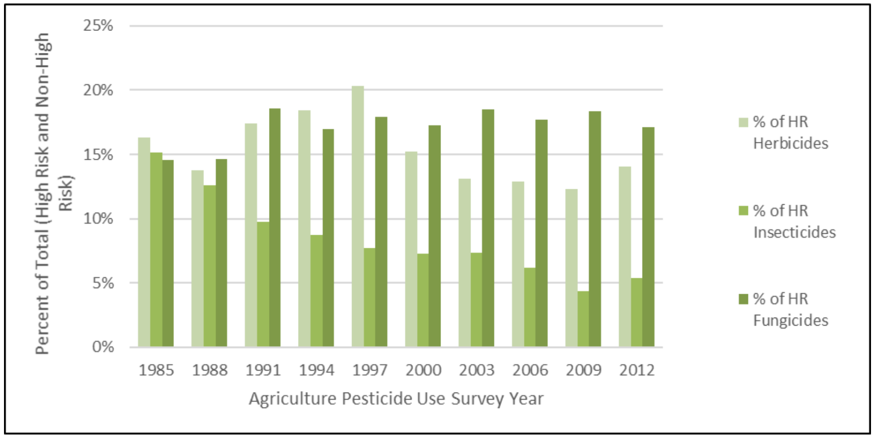

Figure 5. The percent of high risk (HR) agricultural pesticides by class described as a percent of the total pesticides applied for agricultural use.

Outlook and Implications

In reporting and evaluating pesticide use, it is important to consider the many diverse influences on pesticide use. Weather conditions influence pest pressure and the associated response, as does cropping patterns in agricultural settings. Changing climatic variables, such as increasing temperature and precipitation, may impact pesticide use by altering volatilization and degradation, as well as changing pest populations needing to be addressed. Economic factors, such as the changing demands for seasonal crops and recreational activities can also play a significant role in pesticide use. Finally, the changing land use patterns around the State where many new residential developments are constructed on past agricultural lands also plays a part in shifting pesticide use patterns.

More Information

NJ Department of Environmental Protection, Pesticide Control Program, http://www.state.nj.us/dep/enforcement/pcp/ .

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