

FORUM: Environmental Commission 2

QUESTION OF: Tackling the effect of mass pesticide usage on bee colonies

STUDENT OFFICER: Rafaella Boutzoulgian

POSITION: Deputy President

INTRODUCTION

In the past two decades, scientists have observed that the number of bee colonies has been decreasing alarmingly. This is the Colony Collapse Disorder (CCD) phenomenon and the main factor behind it is pesticides. Pesticides are usually used on bees to get rid of parasites and bacteria, which are considered harmful to bee colonies. Bees can get exposed to pesticides via congestion of residue found in nearby water bodies, honey, or pollen. The insecticide residue is then unknowingly fed to bee larvae and queen bees, which can cause bee colonies to collapse. Although most pesticides are mostly used on crops or flowers, people also often spray pesticides directly on flying bees or even hives, so as to remove them from an area, which causes immediate death from poisoning.

Ever since 2006, the year in which the term “Colony Collapse Disorder” was first introduced, the honey bee population has been decreasing at an alarming rate. Even though bees are commonly seen as unwanted insects, it is crucial to consider how important they are, not only as part of ecosystems and the animal chain but also as an industry. Bees are the greatest pollinators among other insects and flying animals that highly contribute to international food security, as well as production. They pollinate most of the world’s leading food crops as well as plantations, which helps to keep ecosystems healthy and viable. Thus, a decrease in bee colonies signifies a decrease in bee-made products and a large increase of their prices. In conclusion, bees play a vital role in ecosystem and biodiversity maintenance globally.

DEFINITION OF KEY TERMS

Bee colony

A group of honeybees kept in a beehive or apiary.

Pesticide

Substance specifically used to repel or destroy any type of pest.

Pest

An insect or small animal that destroys garden plants or crops.

Colony Collapse Disorder (CCD)

The phenomenon that describes the sudden decrease in the bee population.

Apiary

A bee yard where bees are kept to collect beeswax, honey, and royal jelly.

Biodiversity

The variety of all living organisms and species on Earth.

Ecosystem

A community of living organisms that interact with each other and the surrounding environment.

BACKGROUND INFORMATION

The beginning of pesticide usage

Pesticides were used as early as the 19th century, however, most of them contained toxic chemicals and substances that made their frequent usage difficult, so they were

restricted. Before and during WW2, a pesticide known as “Dichloro-Diphenyl-Trichloroethane”. Dichloro-diphenyl-trichloroethane (DDT) was invented and used to kill insects that carried deadly diseases such as malaria. It was the first pesticide to contain organic chemicals, compared to earlier patents that consisted of arsenic and other poisonous substances. By 1945, DDT was available for agricultural use and was used until the 1980s, when the United States Environmental Protection Agency restricted most of DDT applications.

Since pesticides gained attention during the 1940s, scientists composed many more chemical formulas with the same effects of DDT, such as neonicotinoids. More specifically, a formula called “Imidacloprid” was created in 1988 and registered with the Environmental Protection Agency in 1994. Imidacloprid, like the rest of the neonicotinoids, targets insects’ nervous receptors, leading to immediate paralysis and death. Additionally, neonicotinoids are toxic to mammals if a large dosage is ingested.

Pesticide effects on bee colonies

Bees are exposed to pesticides either through sprayed flowers or soil and sometimes through direct contact when the beehives are being sprayed. Beehives are usually sprayed with pesticides to eliminate harmful bacteria and unwanted parasites. Pesticide exposure, other than death, can prevent larvae from developing, attack the bees’ immune systems and cause abnormal behavior like tremors and inability to fly or pollinate. To conclude, as the worker bees’ health deteriorates, so does their ability to pollinate and produce honey, putting the queen bee’s life in danger. Once the queen dies, the hive cannot survive.

In the worst cases, bees that are exposed to toxic pesticides such as neonicotinoids and organophosphates are extremely prone to acute poisoning which can lead to full-body paralysis and death. Forager, also known as worker bees are most vulnerable to pesticide toxicity as they are the ones collecting nectar and pollen. The continuous loss of worker bees can result in food shortage within colonies, which immediately affects colony health and population.

Even in cases where bees are exposed to pesticide residue, their cognitive abilities like memory and navigation, as well as development can sustain irreversible damage. Thus, this can affect a colony’s productivity as a whole since forager bees won’t be easily able to find their way back to their hive to supply their colony with nectar.

Human exposure to pesticides

The most common type of human exposure to pesticides is through diet, when pesticide residue is consumed that can be found in different fruit, vegetables and some animal products. Seeing as pesticides can be often detected in water bodies such as lakes or rivers, it is quite easy for farm animals to consume pesticides, which is then found as residue in their meat. Pesticide exposure is also extremely common in agricultural workers like farmers who transmit pesticide residue home on their clothing.

Moreover, human pesticide exposure is considered a public health hazard due to the potential chronic health effects. Pesticides can be toxic to humans due to their formula, level of toxicity, and exposure duration. Exposure also implies different health effects for different ages.

It has been scientifically verified that children present a higher sensitivity to pesticide exposure than adults since their body development is at an early stage. Thus, their bodies are unable to expel toxic chemicals once ingested. There are many ways a child can be exposed to pesticides. First and foremost is through the womb, meaning that if a pregnant woman ingests pesticides of any sort, the fetus's development can be negatively hindered. Moreover, pesticide exposure is also common within households or daycare centers. And last but certainly not least, children can be exposed to pesticides through contaminated water consumption or residue found in foods.

Common pesticides and their environmental impact

Insecticides

Insecticides are specific chemical formulas that are used to regulate insect populations in different areas or to prevent them from reproducing and damaging crops. Insecticide usage is common in agricultural, public health, and industrial facilities, as well as households.

Other than the impact on honeybee colonies, insecticides also have a great impact on the environment and the animal food chain. Since pesticides are commonly used in agriculture, it is normal for soil to become contaminated which degrades its biodiversity. Once the soil is contaminated, its water retention begins to deteriorate which affects plants, as well as crop growth. Additionally, insecticide contamination of an area can disrupt the

food chain, since many animals will find it difficult to find non-toxic food sources, which can cause them to migrate.

Fungicides

Fungicides are chemical agents that target fungi so as to prevent infestation. They are commonly used to regulate fungal infestations in agriculture and gardening. Even though fungicide application is supposedly targeting fungi, it can disrupt the microorganisms within the soil that play a major role in nutrient transportation, organic matter decomposition and soil quality retention. Once these microorganisms are affected, the soil can become infertile which hinders plant growth. Moreover, fungicides can also impact pollinating insects like honeybees and natural pest predators through soil, plant and water contamination, which can lead to biodiversity degradation and disruption of natural pest control mechanisms. Lastly, fungicides that are applied near bodies of water like lakes or rivers can affect aquatic life since they are toxic to most fish, as contact can cause reproductive and developmental issues.

Different types of bees

Worker bees

Although all worker bees are born female, they do not possess the same abilities as the queen bee. They are unable to reproduce and their lives' only purpose is to work for their hives and queen. Some of the worker bees' duties include cleaning the hive, taking care of the queen by cleaning her, feeding her and removing her waste, collecting nectar to make honey and guarding the hive by flying around it, if they sense any predators.

Drone bees

Drone bees are all male bees whose only job is to mate with the queen to produce offspring. However, drones that are unable to meet a queen's or hive's standards will be removed from the hive by worker bees or killed by the queen bee. Usually, drones show up during spring or summer. They are much larger compared to worker bees and do not collect food. Even though drones' only purpose is breeding with the queen, only 6-8 drones are actually given the chance. Once they breed with the queen, they are ejected from the hive by the worker bees in the fall. Drones are unable to kill or produce honey, as their sole purpose is mating.

The queen bee

The queen bee's sole purpose is to lay eggs, which is why other bees are needed to maintain the hive's safety, and honey production and also tend to the queen's needs. The queen bee is the largest bee in a hive and can lay approximately 1500-2000 eggs a day. However, this does not happen daily, as there are days where queen bees do not lay any eggs. When she does lay eggs, she is able to control the sex of the eggs she lays. She either lays a fertilized female or unfertilized male egg. The queen fertilizes the egg by selectively releasing sperm from her spermatheca as the egg passes through her oviduct.

CCD effects on biodiversity

The Colony Collapse Disorder phenomenon is a major threat to agriculture, ecosystems and most importantly, biodiversity since it targets honeybees, which play a vital role in plant growth and crop retention. Since most wild plants rely on honeybee pollination to grow and survive, the sudden decrease in their population can greatly affect plant reproduction and can cause many varieties of flora to go extinct. That by itself is enough to cause ecosystems to collapse, as many animals rely on seeds and fruit for survival. Lastly, if animals are unable to find food in their designated habitat, they might turn to migration to different habitats as a way of survival, which again immediately affects ecosystems and can lead them to extinction, as it is not certain they are able to survive in foreign habitats.

Colony Collapse Disorder (CCD) effects on global economy

As it has been previously mentioned, more than 75% of the world's crops rely on honeybee pollination to a large extent. Especially crops such as fruits and vegetables whose

growth solely relies on bee pollination. Thus, a decline in bee population signifies a decrease in crop yields, which can result in direct economic losses for the agriculture industry. Not only that, the lack of pollination can also lead to limited food supply globally.

In order to enhance crop yields, farmers would have to use pollination services, meaning they would rent bee colonies to pollinate their crops. And even though it may seem like a feasible solution to sustainable agriculture, it must be considered that pollination services' prices would significantly increase due to the declining bee population. Thus, the use of pollination services would lead to negative results like profit loss and higher prices for fruits and vegetables.

Last but not least, the decline in honeybee population can negatively impact food security globally, but especially in countries where alternative pollination methods such as pollination services are not easily accessible.

MAJOR COUNTRIES AND ORGANIZATIONS INVOLVED

Argentina

Argentina is the second largest honey producer and export country globally, with 70,000 tons of honey produced annually. As well as a honey producer, it is also a large crop producer that uses harmful pesticides such as "chlorpyrifos". Even though chlorpyrifos residue has been detected multiple times in honey exported from Argentina, the country's government has yet to introduce any legislation regarding pesticide use or acceptable dosage.

China

China is the largest honey export, consumption, as well as production country, meaning it requires strict regulation measures for pesticide usage as well as dosage. Pesticides are regulated by the Chinese Ministry of Agriculture and Rural Affairs according to the State Council Decree 677, which obligates that all pesticides imported from other countries are registered and examined for chemicals that are harmful to bees and ecosystems. Furthermore, beekeepers in China are frequently supervised, as legal penalties

such as fines or license suspension for those that use toxic materials and dosages have been increased.

United States of America (USA)

In the United States of America, 75% of produced fruit, nuts and vegetables are pollinated by bees, meaning that the country's agriculture is highly dependent on its bee population. Although bees play a vital role in maintaining its economy, the United States has yet to develop regulations regarding the use of pesticides on crops as they are not considered unsafe for human consumption. The first action that was taken to regulate pesticide use dates to March of 2021. In March of 2021, Massachusetts became the first state in the United States of America to establish regulations that restrict the use of pesticides called "neonicotinoids," which can drastically impact bees' health and development. This measure proved to be effective, as it allowed ecologically friendly products to gain popularity as a substitute for neonicotinoids, such as entomopathogenic nematodes, which are microorganisms within the soil that attack harmful pests without harming insects, animals or humans.

Environmental Protection Agency

As the primary federal agency that regulates pesticides in the United States, the Environmental Protection Agency registers all pesticides, sets tolerance levels for pesticide residues in food and evaluates the environmental, as well as health hazards of pesticides. Furthermore, it is responsible for enforcing regulation according to laws passed by Congress and assessing states' compliance with environmental standards through frequent inspections. In order to properly address environmental issues, the agency takes part in research conducted by universities, environmental organizations like (WWF) and government agencies so as to be able to develop updated scientific methods for environmental preservation. Lastly, the Environmental Protection Agency (EPA) has been raising awareness on the dangers of global warming, sustainable resource use and the importance of considering environmental risks that can harm pollinators.

Food and Agriculture Organization (FAO)

The Food and Agriculture Organization of the United Nations, which was founded on October 16, 1945, whose main areas of expertise are agricultural development, food equity and rural poverty has been engaging in so-called “joint meetings” with the World Health Organization to discuss the risks of unsupervised pesticide usage and the potential of ecologically friendly substitutes. By cooperating with the World Health Organization, the chances of new products that will function as substitutes to pesticides will automatically increase, as there will be more information available regarding the correlation of human consumption to crop quality. Thus, this measure automatically contributes to sustainable usage of harmless pesticides.

TIMELINE OF EVENTS

Date	Description of Event
1910	U.S. Congress publishes and passes the Insecticide Act of 1910, that obligated pesticide labels to mention all contained chemicals
1940s	Development and usage of DDT (dichloro-diphenyl-trichloroethane)
16 October 1945	Establishment of the UN’s Food and Agricultural Organization (FAO)
1962	“Silent Spring” is published by Rachel Carson, which raised awareness on the environmental impact of “DDT”
1970	Establishment of the U.S. Environmental Protection Agency
May 22, 1992	Adoption of the United Nations Convention on Biological Diversity (CBD)
December 29, 1993	Enforcement of the United Nations Convention on Biological Diversity (CBD)
1999	The Stockholm Convention on Persistent Organic Pollutants is adopted globally, which restricts the persistent use of harmful pesticides like DDT

September 2006	The World Health Organization approves the use of DDT in African countries as a means of eliminating malaria The term “Colony Collapse Disorder” was first introduced
2009	European Commission enforces directive on Sustainable Use of Pesticides (SUD)
11 December 2019	European Commission presents “Green Deal”
2022	The U.S. Court of Appeal orders the Environmental Protection Agency to reevaluate the safety of glyphosate, regarding its connection to carcinogenicity
22 June 2022	Presentation of “Sustainable Use of Pesticide Regulation” by the European Commission

UN INVOLVEMENT: RELEVANT RESOLUTIONS, TREATIES AND EVENTS

“FAO International Pollinator Strategy”

This initiative, introduced by the Food and Agricultural Organization advocates for sustainable agriculture practices such as pesticide substitutes and promotes to protect pollinators like bees. Through this initiative, the Food and Agriculture Organization has created a better understanding of pollinators’ requirements and dangers, so as to raise awareness on the effects of pesticides. The main objective is conservation and sustainable use of pollination services in agriculture by addressing environmental challenges faced by pollinators and monitoring pollinator populations in order to comprehend the causes of their

decline. Lastly, this strategy aids in policy development that can boost sustainable agriculture via pesticide guidelines and pollinator habitat protection.

United Nations Convention on Biological Diversity (CBD)

The CBD's strategy raises awareness on the protection of biodiversity and that of pollinators. In its clauses, it urges Member States to adopt policies and ratify conventions that restrict pesticide use. This convention has been proven to be effective, as the countries that are part of it have managed to develop regulation on pesticide usage and manage the tolerance levels of pesticide residue in foods. Moreover, it is considered one of the most widely adopted agreements regarding environment protection. The three main objectives include biological diversity conservation, sustainable use of biological diversity and natural resource equity.

United Nations Development Programme

This programme conducts different initiatives that evaluate and benefit biodiversity, as well as ecosystem management around the world, including practices that aim to preserve bee colonies. Furthermore, UNDP has funded and conducted different projects that aim to conserve ecosystems by protecting pollinators. They also advocate for sustainable agricultural practices, as it promotes them through its projects. Some examples of those practices are toxic pesticide reduction, pesticide substitution and beekeeping safety measures. UNDP's methods have helped many countries that lack pesticide regulation with their projects, as they have provided a plethora of sustainable solutions to CCD and pesticide exposure.

POSSIBLE SOLUTIONS

Pesticide substitutes

Since pesticides are commonly used to eliminate unwanted bacteria, predators or pests, farmers and agriculture experts should aim to substitute toxic pesticides by introducing natural and harmless methods of repelling pests. An example of a "natural pesticide" would be the inclusion of natural predators such as ladybugs or lacewings in

apiaries, so as to target pests. Although this method is not as immediate as pesticides, it is less harmful and supports ecosystem maintenance.

In order for pesticide substitutes to be implemented worldwide, the development of alternative substances and pollination methods is required. Moreover, in order for pesticide substitutes to be used correctly, national governments along with environmental organizations should aim to create conjoined frameworks that instruct agriculture producers to use them safely and effectively.

Pesticide Regulation

In many countries around the world, pesticide regulation has yet to be introduced, due to the lack of information and evaluation. It is still a common belief that pesticides benefit production when in reality they are damaging natural products and pollinators. Governments should aim to conduct regulations or introduce legislations that control pesticide usage by examining dosage level tolerance and residue tolerance in foods in order to pass laws that benefit human health and the environment.

Although the development of pesticide regulation is crucial, it is important to consider that most pesticide regulations require further instructions and guidelines to ensure pollinator viability. Frequent reviewing and assessment of national pesticide laws can enhance environmental standards and environmental law enforcement.

Integrated Pest Management

Integrated Pest Management (IPM) is an ecologically friendly alternative method to chemical pest control that includes different combinations of crop management, bee product production, and pest infestation methods. The main objective is pest identification by assessing crops through a process known as “scouting”, which describes the visual inspection of crop yields. The key point of scouting is the distinction of harmful pesticides from beneficial insects and microorganisms that pose no threat to the soil, the crops and pollinators whatsoever. This step is crucial to preventing unnecessary pesticide and fungicide application. Lastly, if pests cannot be removed by any means, the Integrated Pest

Management method promotes the use of natural pest predators such as ladybugs that can easily target and eliminate all kinds of pest varieties.

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