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Colony Collapse Disorder- A Major Threat to Beekeeping Industry

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INTRODUCTION

Honeybees are considered as a keystone species because of the significant role they play in supporting various ecosystems and biodiversity through their massive pollination services. United Nations (FAO) estimated that bees pollinate 70% of crop species that provide 90% of food supplies worldwide. More than 1/3rd of the crop production depends on bee pollination. Bees do not pollinate the crop plants intentionally; they are pollen and nectar feeders which end up by providing this valuable pollination. In 2006, it has been reported that bee colony were dying in mass and was first reported from USA. Such mysterious dying of bees is called as colony collapse disorder. The ecological and economic contributions of honeybees are invaluable, which makes colony collapse disorder a major threat to bee keeping industry and we cannot afford the losses of bees, than what is going on or what is happening to bees.

CCD rises following questions:

1. What is CCD
2. Is there any symtomological characterization of CCD
3. What are the possible contributing factors to cause CCD

What is CCD?

The phenomenon that occurs when the majority of worker bees in a colony disappear and leave behind a queen, plenty of food and a few nurse bees to care for the remaining immature bees and the queen.

Symptoms of CCD

In collapsed colonies

- Complete absence of adult bees in colonies, with few or no dead bees in or around colonies
- Presence of capped brood

Presence of food stores (both honey and bee bread) that are not robbed by other bees or typical colony pests (small hive beetles, wax moths, etc.). If robbed, the robbing is delayed by a number of days.

In collapsing colonies

- ❖ Insufficient number of bees to maintain the amount of brood in the colony.
- ❖ Workforce is composed largely of younger adult bees.
- ❖ Cluster is reluctant to consume food provided to them by the beekeeper.

In light of the important ecological and economic values of pollinators, there is a need to take immediate action to identify the possible contributing factors associated with the declining numbers of pollinators in order to sustain crop production and to conserve the biodiversity. The following factors are considered as the possible causes of CCD.

1. Parasites
2. Diseases
3. Malnutrition
4. Genetic diversity
5. Electromagnetic radiation
6. Pesticides

The incidence of parasites and diseases will occur only when the colony become week. So the question is how the colony become week, it may be due to the Malnutrition, lack of genetic diversity, Electromagnetic radiation and pesticides which may be responsible for causing CCD. These factors are discussed below one by one as how they are responsible for CCD.

1) Malnutrition: Malnutrition is a consequence of shipping bees cross-country to pollinate a crop. Most of the bees used for commercial pollination are placed in areas where only one crop is available resulting lack of a good mix of pollens required to rear healthy bees so it may cause weakening of bees defence against parasites and diseases. This may also because, it is often hard to find the natural food e.g. (1) Foraging habitat converted to houses, streets, highways, shopping malls, parking lots, airports and runways resulting increases in habitat loss and decreases in nectar and pollen biodiversity which may leads to CCD.

2) Lack of genetic diversity: Genetic diversity in managed honeybee colonies is another factor contributing to colony collapse disorder. The shortage of genetic diversity may be causing honeybees to become more susceptible to disease, despite the fact that honeybees have numerous defences against parasites and pathogens (Oldroyd, 2007). As artificial insemination of queens and honeybee domestication become more common and as the honeybee gene pool becomes smaller, infestations of parasites and pathogens will become more common which may be responsible for CCD. As higher the genetic diversity within a hive, the more resilient the hive is to parasites and pathogens.

Electromagnetic radiation: Electromagnetic radiation (EMR) can be defined as energy propagated through space that exhibits wave-like. Honeybees, like other animals, use the Earth magnetic fields for navigation purposes. It is thought that electromagnetic fields can act on the dendrites and the signal is amplified by the hairs, as a result generating a stimulus in the nerve. Rapid development of cell phone towers, alter the behavioral pattern of bees when they are in close proximity to mobile phones and towers. The vanished bees are never found, but thought to die singly far from home. The massive amount of radiation produced by towers and mobile phones affecting the navigational skills of the honey bees because when an electromagnetic beam passes through tissue or other absorbing matter, part of its energy is absorbed causing thermal effects and preventing them from returning back to their hives.

Table 1: Change in colony status of honeybees exposed to mobile phones

Parameter	Control	10 days After exposure
No. of worker bees leaving the hive entrance/ minute)	40.7±15	
Before exposure	41.5±14	38.2±12
During exposure	42.4±14	18.5±13
After exposure		Nil
Returning ability	42.5±15	
Before exposure	43.6±14	39.5±14
During exposure	44.6±13	15.6±13
After exposure		Nil
Bee strength		
Before exposure	9 Frame	9 Frame
During exposure	9 Frame	5 Frame
After exposure	9 Frame	1 Frame
Egg laying rate of queen /day		
Before exposure	365.25	355.10
During exposure	362.15	198.60
After exposure	350.15	100.00

(Sainudeen, 2011)

(4) Pesticides: Agriculturalists use chemicals on plant crops to deter or kill unwanted insects. Honey bees may come in contact with pesticides as they collect pollen from these sources and transport it back to the hive. Contamination of the hive would cause the bees to leave or die off. Among the pesticide one of the classes of insecticide i.e neonicotinoids is making headlines or burning issue around the world. The neonicotinoids are the new group of insecticide which act by blocking the nicotinic acetylcholine receptor in the post synaptic membrane. Exposure to these insecticides may affect the memory formation gene (*creb* and *pka*) and foraging activity of bees.

❖ **Primary routes of neonicotinoid exposure to bees**

Primarily bees may come in contact with neonicotinoid exposure via direct contact while foraging during bloom, Exposure to residues after heavy dew, Drift on non-crop flowering vegetation. These exposures may cause acute, chronic and sub lethal effects resulting death of bees. There are 100 fold variations in acute toxicity according to kind of bee and season. This variation in sensitivity could explain why some colonies die from CCD and other do not.

❖ **Secondary routes of neonicotinoid exposure to bees**

Residues in plant fluids released by guttation droplets

Residues in contaminated water (i.e. spills, irrigation)

Residues in nectar and pollen represent the major route of neonicotinoid exposure to bees.

CONCLUSION

Colony Collapse Disorder poses a greater threat to the beekeeping industry as they affect crop production and productivity. A perfect storm of stressors is putting the honeybees at risk of extinction. Due to the lack of diversity within agro-ecosystems to support healthy pollinator communities so humans will be at risk losing one of our most valued necessities, food. No single factor is responsible for colony collapse disorder. Among all the discussed factors, pesticide particularly neonicotinoids are of greater concern in different parts of the world in the recent years. As neonicotinoids are systemic pesticides, they are easily translocated through the plant system and are found in floral parts such as pollen and nectar etc. which could either alter the behavior or kill pollinators**.** There is a greater variation in sensitivity of the honeybees to neonicotinoids and the exact cause of CCD, still unknown so

an extensive research is needed to evaluate reason behind CCD.

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