

**Questions 42-52 are based on the following passage and supplementary material.**

This passage is adapted from Richard J. Sharpe and Lisa Heyden, "Honey Bee Colony Collapse Disorder is Possibly Caused by a Dietary Pyrethrum Deficiency." ©2009 by Elsevier Ltd. Colony collapse disorder is characterized by the disappearance of adult worker bees from hives.

Honey bees are hosts to the pathogenic large ectoparasitic mite *Varroa destructor* (Varroa mites).

Line These mites feed on bee hemolymph (blood) and can  
kill bees directly or by increasing their susceptibility  
5 to secondary infection with fungi, bacteria or viruses.  
Little is known about the natural defenses that keep  
the mite infections under control.

Pyrethrums are a group of flowering plants which  
include *Chrysanthemum coccineum*, *Chrysanthemum*  
10 *cinerariifolium*, *Chrysanthemum marschalli*, and  
related species. These plants produce potent  
insecticides with anti-mite activity. The naturally  
occurring insecticides are known as pyrethrums.  
A synonym for the naturally occurring pyrethrums is  
15 pyrethrin and synthetic analogues of pyrethrums are  
known as pyrethroids. In fact, the human mite  
infestation known as scabies (*Sarcoptes scabiei*) is  
treated with a topical pyrethrum cream.

We suspect that the bees of commercial bee  
20 colonies which are fed mono-crops are nutritionally  
deficient. In particular, we postulate that the problem  
is a diet deficient in anti-mite toxins: pyrethrums,  
and possibly other nutrients which are inherent in  
such plants. Without, at least, intermittent feeding on  
25 the pyrethrum producing plants, bee colonies are  
susceptible to mite infestations which can become  
fatal either directly or due to a secondary infection of  
immunocompromised or nutritionally deficient bees.  
This secondary infection can be viral, bacterial or  
30 fungal and may be due to one or more pathogens.  
In addition, immunocompromised or nutritionally  
deficient bees may be further weakened when  
commercially produced insecticides are introduced  
into their hives by bee keepers in an effort to fight  
35 mite infestation. We further postulate that the proper  
dosage necessary to prevent mite infestation may be  
better left to the bees, who may seek out or avoid  
pyrethrum containing plants depending on the  
amount necessary to defend against mites and the  
40 amount already consumed by the bees, which in  
higher doses could be potentially toxic to them.

This hypothesis can best be tested by a trial  
wherein a small number of commercial honey bee  
colonies are offered a number of pyrethrum  
45 producing plants, as well as a typical bee food source  
such as clover, while controls are offered only the  
clover. Mites could then be introduced to each hive  
with note made as to the choice of the bees, and the  
effects of the mite parasites on the experimental  
50 colonies versus control colonies.

It might be beneficial to test wild-type honey bee  
colonies in this manner as well, in case there could be  
some genetic difference between them that affects the  
bees' preferences for pyrethrum producing flowers.

Pathogen Occurrence in Honey Bee Colonies With and  
Without Colony Collapse Disorder

Pathogen	Percent of colonies affected by pathogen	
	Colonies with colony collapse disorder (%)	Colonies without colony collapse disorder (%)
Viruses		
IAPV	83	5
KBV	100	76
Fungi		
<i>Nosema apis</i>	90	48
<i>Nosema ceranae</i>	100	81
All four pathogens	77	0

Adapted from Diana L. Cox-Foster et al., "A Metagenomic Survey of Microbes in Honey Bee Colony Collapse Disorder." ©2007 by American Association for the Advancement of Science.

42

How do the words “can,” “may,” and “could” in the third paragraph (lines 19-41) help establish the tone of the paragraph?

- A) They create an optimistic tone that makes clear the authors are hopeful about the effects of their research on colony collapse disorder.
- B) They create a dubious tone that makes clear the authors do not have confidence in the usefulness of the research described.
- C) They create a tentative tone that makes clear the authors suspect but do not know that their hypothesis is correct.
- D) They create a critical tone that makes clear the authors are skeptical of claims that pyrethrums are inherent in mono-crops.

43

In line 42, the authors state that a certain hypothesis “can best be tested by a trial.” Based on the passage, which of the following is a hypothesis the authors suggest be tested in a trial?

- A) Honeybees that are exposed to both pyrethrums and mites are likely to develop a secondary infection by a virus, a bacterium, or a fungus.
- B) Beekeepers who feed their honeybee colonies a diet of a single crop need to increase the use of insecticides to prevent mite infestations.
- C) A honeybee diet that includes pyrethrums results in honeybee colonies that are more resistant to mite infestations.
- D) Humans are more susceptible to varroa mites as a result of consuming nutritionally deficient food crops.

44

Which choice provides the best evidence for the answer to the previous question?

- A) Lines 3-5 (“These mites . . . viruses”)
- B) Lines 16-18 (“In fact . . . cream”)
- C) Lines 19-21 (“We suspect . . . deficient”)
- D) Lines 24-28 (“Without . . . bees”)

45

The passage most strongly suggests that beekeepers’ attempts to fight mite infestations with commercially produced insecticides have what unintentional effect?

- A) They increase certain mite populations.
- B) They kill some beneficial forms of bacteria.
- C) They destroy bees’ primary food source.
- D) They further harm the health of some bees.

46

Which choice provides the best evidence for the answer to the previous question?

- A) Lines 1-2 (“Honey bees . . . mites”)
- B) Lines 6-7 (“Little . . . control”)
- C) Lines 31-35 (“In addition . . . infestation”)
- D) Lines 47-50 (“Mites . . . control colonies”)

47

As used in line 35, “postulate” most nearly means to

- A) make an unfounded assumption.
- B) put forth an idea or claim.
- C) question a belief or theory.
- D) conclude based on firm evidence.

48

The main purpose of the fourth paragraph (lines 42-50) is to

- A) summarize the results of an experiment that confirmed the authors’ hypothesis about the role of clover in the diets of wild-type honeybees.
- B) propose an experiment to investigate how different diets affect commercial honeybee colonies’ susceptibility to mite infestations.
- C) provide a comparative nutritional analysis of the honey produced by the experimental colonies and by the control colonies.
- D) predict the most likely outcome of an unfinished experiment summarized in the third paragraph (lines 19-41).

49

An unstated assumption made by the authors about clover is that the plants

- A) do not produce pyrethrums.
- B) are members of the *Chrysanthemum* genus.
- C) are usually located near wild-type honeybee colonies.
- D) will not be a good food source for honeybees in the control colonies.

50

Based on data in the table, in what percent of colonies with colony collapse disorder were the honeybees infected by all four pathogens?

- A) 0 percent
- B) 77 percent
- C) 83 percent
- D) 100 percent

51

Based on data in the table, which of the four pathogens infected the highest percentage of honeybee colonies without colony collapse disorder?

- A) IAPV
- B) KBV
- C) *Nosema apis*
- D) *Nosema ceranae*

52

Do the data in the table provide support for the authors' claim that infection with varroa mites increases a honeybee's susceptibility to secondary infections?

- A) Yes, because the data provide evidence that infection with a pathogen caused the colonies to undergo colony collapse disorder.
- B) Yes, because for each pathogen, the percent of colonies infected is greater for colonies with colony collapse disorder than for colonies without colony collapse disorder.
- C) No, because the data do not provide evidence about bacteria as a cause of colony collapse disorder.
- D) No, because the data do not indicate whether the honeybees had been infected with mites.

**STOP**

**If you finish before time is called, you may check your work on this section only.  
Do not turn to any other section.**