

Insect and Plant Interactions



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Thought Question

Question:
What does the Cold War and Insect/Plant Interaction have in common?



The first man-made nuclear explosion, in the New Mexico desert, July 16, 1945.

(CNN, 2005)

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Answer

Plants and insects are in a never ending "arms race" with each other!

Plant/insect interactions existed millions of years ago!

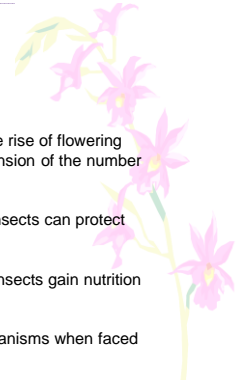
Plants fight back against the insects that consume them for energy. But insects have developed many strategies for countering these mechanisms.



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Objectives

- Explain the connection between the rise of flowering plants (angiosperms) and the expansion of the number of insect species.
- Using examples, explain the how insects can protect and help propagate plants.
- Describe the major ways in which insects gain nutrition (phytophagy) from the plant.
- Describe the plant protection mechanisms when faced with herbivory.



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Introduction

- Plants house sweet nectars that attract insects.
- This encourages the arrival of pollinators.
- This mutually benefits both organisms.
- In other cases, the insect would rather feed on plant tissues.
- More than half of all insects are plant feeders!
- The biggest concern are "outbreaks" like the biblical plagues of locusts.
- Some conditions lead to defoliation of entire fields of crops!



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The Beginning

- Plants emerged onto land first.
- Insects followed, and used them for food.
- This feeding pressure triggered the development of plant defenses.
- Insects responded with defenses of their own.
- This interaction accelerated evolution of both organisms.
- Plants grew higher up.
- Insects developed wings.
- More complex relationships developed.



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Flowering Plants

- Flowering plants (**angiosperms**) need pollen to contact their **stigma** for reproduction.
- Seeds develop in the flower ovary.
- Initially, many plants were wind pollinated.
- Insects inadvertently pollinated plants as they fed on the sweet nectar in the flowers.
- That relationship proved efficient.
- Now, specific pollinator interactions exist
- Bees like bright blues and purples.
- Moths like dusk blooming, pale flowers.
- Butterfly targeting plants have landing platforms for the insect.

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Mutualism

Popular opinion represents insects as principle agricultural pests. Despite this, without their **mutualistic relationships** with insects, many plants lose their success.

- ✓ Some insects protect plants.
- ✓ Some spread their seeds.
- ✓ Some pollinate the flowers.
- ✓ Some are entirely dependant on their insect counterpart (Yucca moth).



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Mutualism Examples



Seed dispersal

- Ants pick up seeds.
- Ants chew ends off the seeds for food.
- This action promotes germination.

Protection

- Cecropia plant provides shelter and food for the ant
- The ant protects the plant from herbivores.

Reproduction/Pollination

- Butterflies, bees and other insects feed on flower nectar.
- They pick up pollen as they feed.
- They cross pollinate plants with each successive visit.

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Video – Ants in North America



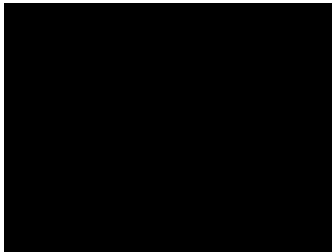
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Video – Cecropia Plants and Azteca Ants



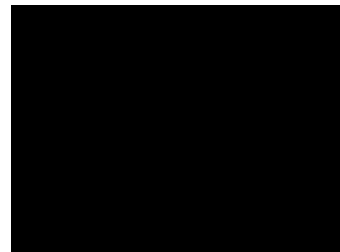
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Video – Butterfly Landing Platforms



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Video – Hover Fly



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More Examples



Some fig trees can only be pollinated by the fig wasp.

Bees are sometimes commercially used to pollinate plants.

Read about it at this website:

<http://www.ars.usda.gov/IS/AR/archive/oct97/pollen1097.htm>.



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More Examples (Continued)



- o Yucca is the state flower of New Mexico.
- o Traditionally, Yucca was used by Native Americans for basket weaving.
- o The Yucca moth is the specific pollinator for Yucca plants, and no other insect does so.
- o Yucca moths emerge from cocoons in the soil in early spring.
- o They congregate on flowering plants.
- o The female deliberately pollinates the Yucca plant in the hope for seeds to feed to her offspring.

The plant and insect are completely dependant on one another.

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Insect Galls

Galls can occur because of fungi, bacteria, nematodes, mites, or insects

Examples: aphids, phylloxerans, psyllids, midges (gall gnats) and cynipid wasps (gall wasps).

Galls were named because they contain large amounts of tannin. They were known as "gallnuts" because they tasted as bitter as gall.



Gall wasp inside oak apple gall

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Insect Galls (Continued)

Plant galls are abnormal growths of cells resultant of a stimulus.

Insect stimuli include:

- egg laying
- Immatures feeding



Homed Oak Gall

- Eggs are laid in the leaf or stem.
- The immature insects can often be found in a cell or cells within the developing gall. Galls develop rapidly, but briefly.
- The insect becomes enclosed by the gall.
- It will feed on gall tissue.

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Gall Locations

Galls occur on stems, leaves, trunks, flowers, fruit, leaf-shoot terminals, petioles and roots.

Galls are unique to the insect species.

Galls rarely seriously harm the plant. Some people look for gall susceptible plants for aesthetics.

- ✓ Insecticides are ineffective treatments for galls.
- ✓ Instead, improve the health of your plant.
- ✓ Fertilize, irrigate, prune and carry out other approved practices.



Oak galling around leaves

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Gall Gallery

Insecticidal control is usually not practical because:

- Damage is not significant most of the time.
- Parasitoids often suppress gall-makers.
- Correct timing of application only controls adults.
- Environmental contamination and expense are involved, especially on larger trees.
- Some galls that occur on the stems and limbs may be handpicked and destroyed.



Gall formed by hickory midge fly



psyllid gall on sugarberry



oak fig gall



oak apple gall



Wasp inside oak apple gall

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Plant Defenses

In extreme cases, severe economic loss results from insects.

Outbreak levels of grasshoppers, caterpillars, locusts, and others can be devastating. Up to 20% of crops are lost annually!

Plants have evolved:

Physical defenses

- ✓ Tough bark
- ✓ Slippery leaves
- ✓ Thorns and plant hairs

Chemical defenses

- ✓ Noxious/distasteful chemicals



Dense plant thorns

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Learning Game Placeholder

Learning Game: Choices

Title: Review Quiz

Conclusion

- Plants colonized land first.
- Insects followed.
- Insects consumed the plants.
- Plants developed physical and chemical defenses.
- Insects then developed ways to get around these defenses.



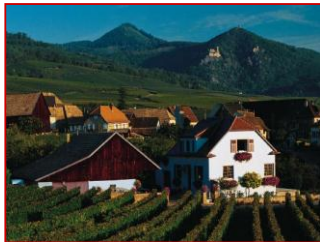
- ✓ Ants eat portions of wildflower seeds which prepares the seed to germinate.
- ✓ Azteca ants protect Cecropia plants in exchange for food.
- ✓ Fig wasps incubate brood in fig fruit in exchange for pollination of the tree.
- ✓ Bees, beetles, hover flies, and others are also pollinators of plants.
- ✓ Orchids have adapted platforms for butterflies to use when sucking nectar.



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Think about it

Now when you hear about insects and plant relationships, hopefully you will think about all the other beneficial insects that play a vital role in the ecosystem.



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References

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