Quiz: What are the types of leaf chewing?

Lecture 3

16/02/2023

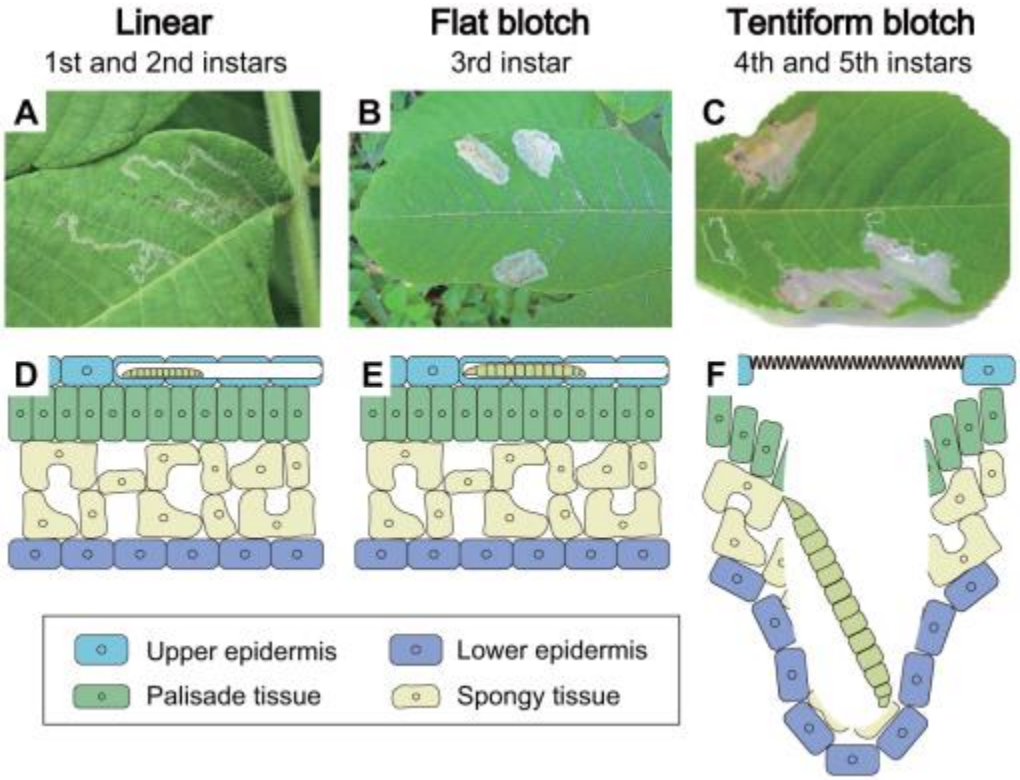
Depth leaf mines

Full depth mine ……. mine can utilise the full thickness of the leaf,

Upper surface leaf mine…… mine can utilise the upper surface of the leaf

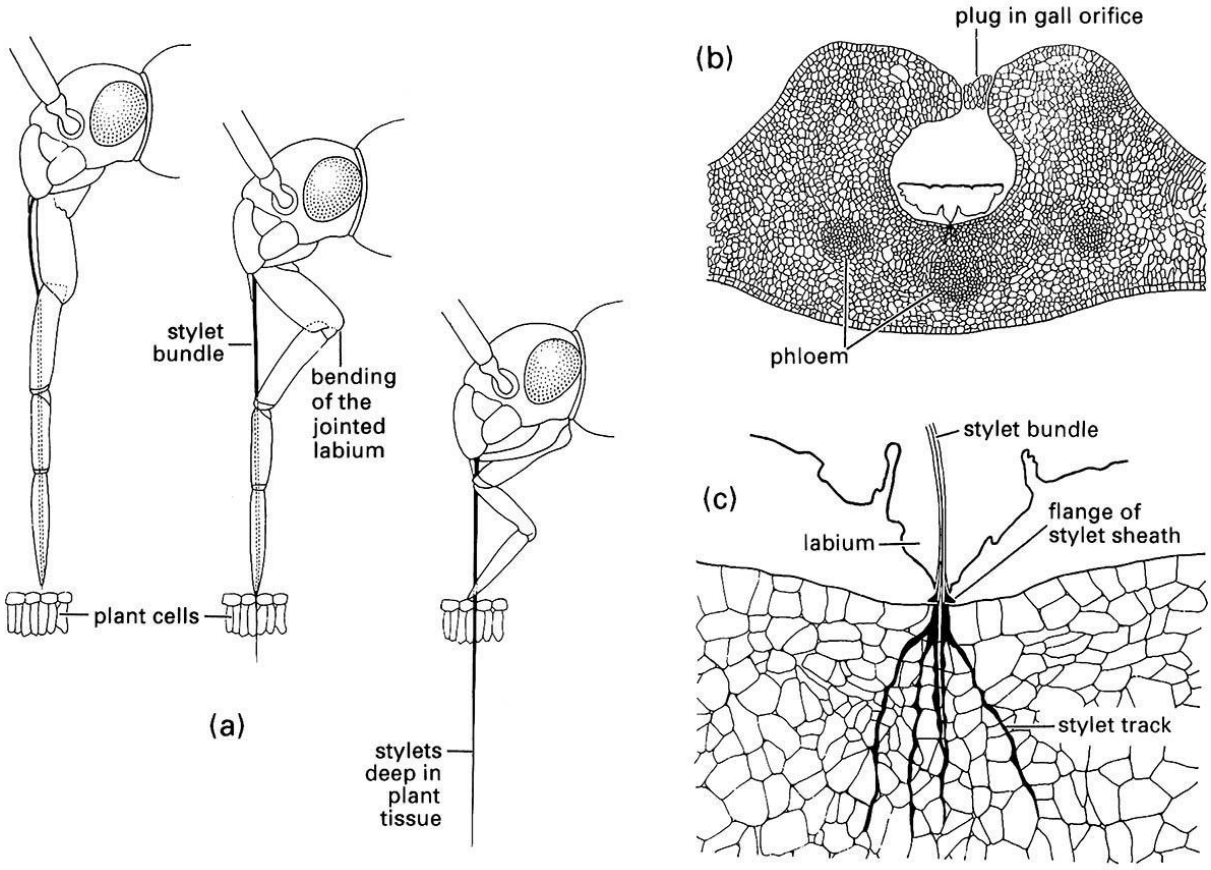
Lower surface leaf mine……. can utilise the lower surface of the leaf

Epidermal mine ……the larvae consume merely the upper and lower surface of the leaf



Sap sucking

The feeding activities of insects that chew or mine leaves and shoots cause obvious damage. In contrast, structural damage caused by sap-sucking insects often is inconspicuous, as the withdrawal of cell contents from plant tissues usually leaves the cell walls intact. Damage to the plant may be difficult to quantify, even though the sap sucker drains plant resources (by removing phloem or xylem contents), causing loss of condition such as retarded root growth, fewer leaves, or less overall biomass accumulation compared with unaffected plants. These effects may be detectable with confidence only by controlled experiments in which the growth of infested and un-infested plants is compared. Certain sap-sucking insects do cause conspicuous tissue necrosis either by transmitting diseases, especially viral ones, or by injecting toxic saliva, whereas others induce obvious tissue distortion or growth abnormalities called galls. Most sap-sucking insects belong to the Hemiptera. All hemipterans have long, thread-like mouthparts consisting of appressed mandibular and maxillary stylets forming a bundle lying in a groove in the labium. The maxillary stylets contain a salivary canal that directs saliva into the plant, and a food canal through which plant juice or sap is sucked up into the insect's gut. Only the stylets enter the tissues of the host plant. They may penetrate superficially into a leaf or deeply into a plant stem or leaf midrib, following either an intracellular or intercellular path, depending on species. The feeding site reached by the stylet tips may be in the parenchyma (e.g. some immature scale insects and many Heteroptera), the phloem (e.g. most aphids, mealybugs, soft scales and leafhoppers) or the xylem (e.g. spittle bugs and cicadas).

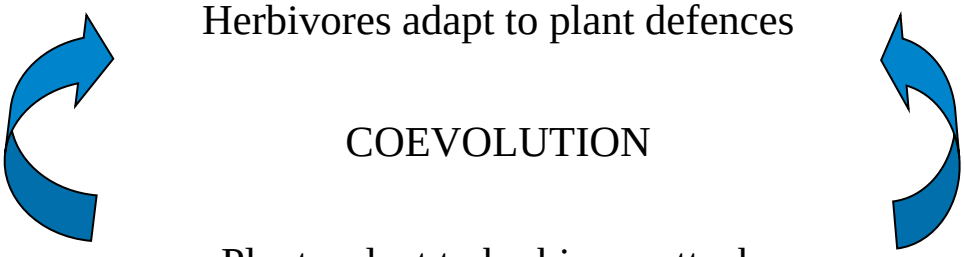


(a) penetration of plant tissue by a mirid bug showing bending of the labium as the stylets enter the plant; (b) transverse section through a eucalypt leaf gall containing a feeding nymph of a scale insect, *Apiomorpha* (Eriococcidae); (c) enlargement of the feeding site of (b) showing multiple stylet tracks (formed of solidifying saliva) resulting from probing of the parenchyma.

What limits herbivore populations?

- ✓ Herbivores rarely consume all of their plant resources: The world is green!
- ✓ At first glance herbivores seem unlikely limited by food resources
- ✓ Are herbivores instead limited by predators or parasites?
- ✓ Or are herbivores limited by the quality of plant food (lack of nitrogen or micronutrients)?
- ✓ Or are herbivores limited by [their ability to overcome] plant defences?

Plant – Herbivore Coevolution



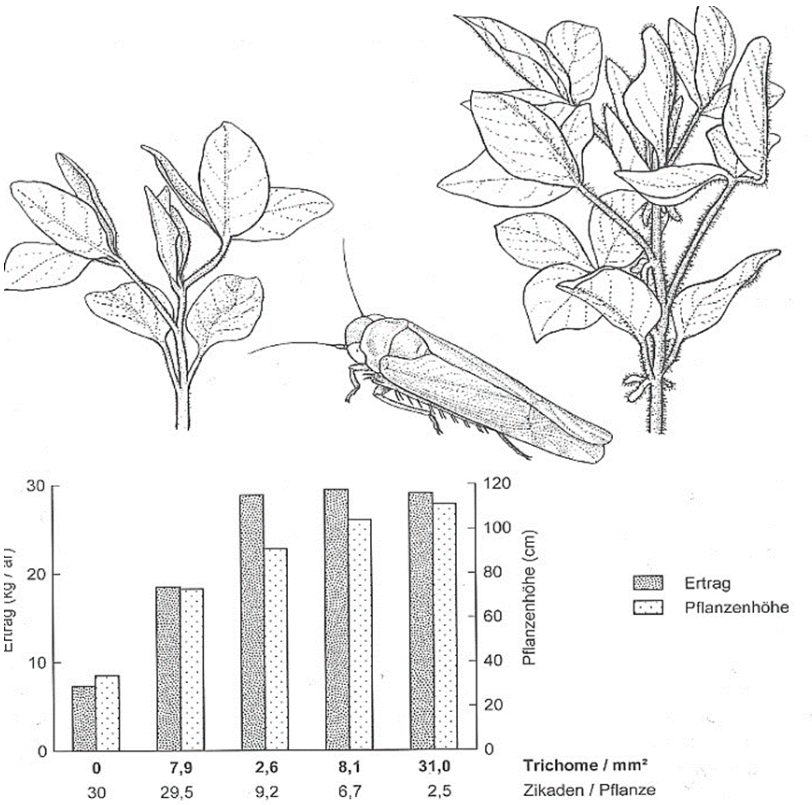
Plant defence

- ✓ No plant is immune against herbivory
- ✓ Most have one or (mostly) several forms of defence:
  - Mechanical: thorns,dense layers of hairs, tough leaves,(lignins,silicate),thick seed coats
  - Toxins and deterrents: plant secondary compounds
  - Size
  - Phenology






Mechanical defence



Soy bean *Cicada Empoasca fabae*

Unavailability in space and time

-Size: A single small seed offers insufficient food for a seed-eating insect larva

-Low population density or ephemeral growth

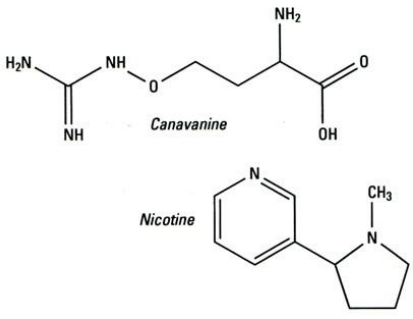
Plant secondary compounds

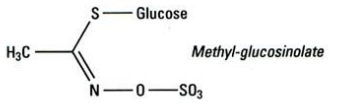
- Enormous structural diversity: Non-protein amino acids,alkaloids, glucosinulates,cyanogenic compounds,terpenoids,coumarins,iridoid glycosides…..

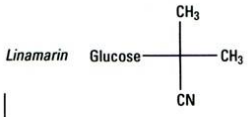
- Previously believed to be only plant waste products

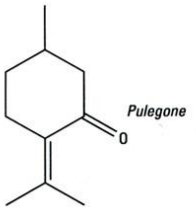
- Current evidence: Produced by the plants under the selective pressure from herbivorous animals as defensive chemicals

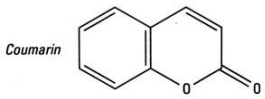
- Are deterrents, toxins or signals to herbivore enemies; quantitative vs. qualitative, defence; constitutive vs. induced defence

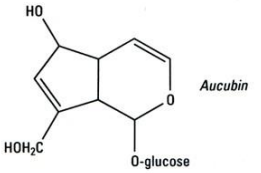












Induced defence

1. Increase of defensive compounds as a dynamic response to herbivory

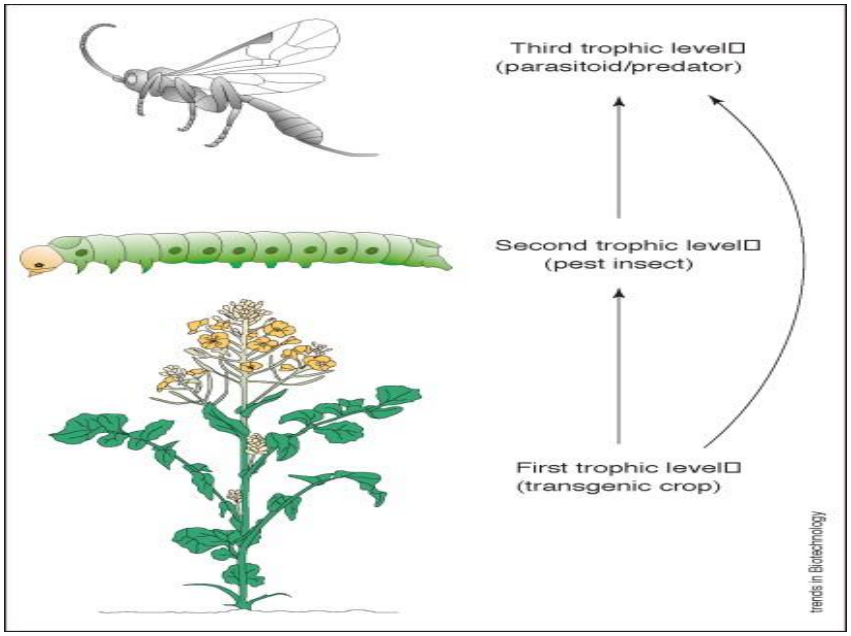
2. Complex responses that are often regulated through Jasmonic acid,(JA)

3. May involve the production and the dissipation into the air of volatile compounds that induce up regulation of defenses in neighboring plants (‚talking trees‘)

4. May involve the attraction of enemies of the herbivores in so-called tritrophic systems (‚call for help‘)

5. Such enemies are often parasitic wasps or flies that lay their eggs on herbivore larvae (they are parasitoids,i.e., kill their host)

Tritrophic interactions



Tri-trophic model of cotton-H. zea-parasitoid interactions