

TreeDivNet

Insect Herbivory Assessment

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At the plot level

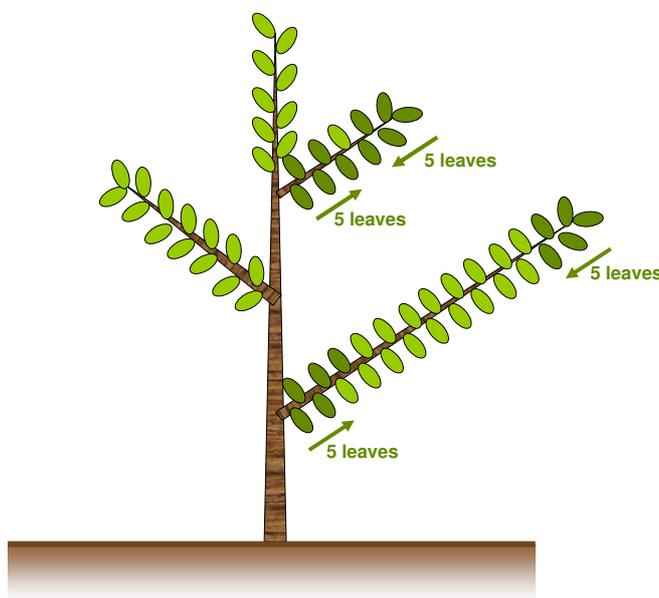
Each experiment has a different spatial design which makes it difficult to propose exactly the same sampling method. However we suggest the following basic principles:

- All plots containing the focal tree species are sampled – they are the replicates of diversity treatments
- In each plot, only trees in the core area are sampled to avoid edge effects (e.g. the two external rows will not be considered).
- A fixed number of trees per focal tree species are assessed irrespective of tree composition of the plot so that damage comparison between monoculture and mixtures can be done on the same number of trees. The same for insect species richness comparisons (e.g. no need for rarefaction procedures)
- To account for possible herbivore aggregation at the plot level, the position of sampled trees are randomly selected in the core area (at the first assessment, then always use the same trees in all following assessments).

At the tree level

1. For deciduous trees

- Measures are made on a fixed number of leaves per tree. For example $10 \times 4 = 40$ leaves with 10 leaves per branch (cut branch if necessary), choosing two facing opposite branches at the top and two facing opposite branches at the bottom of the tree crown.
- 5 leaves are randomly chosen at the tip of a branch and 5 at the basis of the same branch.



- If there are not enough leaves on the branch, one can choose another branch at the same height. If there are not enough branches, one can use the main axis.
- Assessed leaves can be different from one assessment to the next (because some may fall, some may appear, and damage may accumulate).
- The total number of sampled leaves per tree should be adapted to the size of the tree (e.g. 20 for young seedlings, 200 for mature trees) and/or the population density of target insect herbivores.

2. For coniferous trees

- Measures are made on 2 branches (cut branch if necessary) facing opposite directions at the top, and 2 at the bottom of tree crown.
- Herbivory is assessed on a fixed number of shoots (e.g. 5) at the top and at the bottom of each sampled branch.
- For stem damage, the intensity of decortication (or number of boring holes) is estimated on the 4 sampled branches and on the main axis

3. Tentative list of covariates

- Tree height at the end of the growing season
- Tree DBH at the end of the growing season
- Volume of tree crown (for the measure of tree "apparency") as product of mean largest width on the opposite sides \times height of tree crown (or using allometric relationships if available), at each herbivory assessment.
- To be measured on each sample tree + on closest neighbours

Damage estimation

Score	Chewers and Skeletonisers % leaf area damaged	Other categories of pest
0	0	% of leaves or shoots with the presence of insect
1	1 – 5 %	
2	6 – 10 %	
3	11 – 25 %	
4	26 – 50 %	
5	51 – 75 %	
6	more than 76 %	

Time schedule

- Most damage observed on leaves in early spring can remain visible during the rest of the growing season.
- Some guilds do not cause the same type of damage during their development (e.g. *Lymantria dispar* young larvae skeletonise then older larvae chew). As a consequence, there is a risk to attribute damage made by one species to two different feeding guilds.

- Early damage can influence later herbivore recruitment and damage (Wold and Marquis, 1997).
- Damage made by some feeding guilds such as external chewers may obliterate damage previously caused by other guilds.
- Diversity effects on herbivory may change during the season.

According to previous remarks and in order to avoid a false estimation of insect guild richness and diversity, we suggest to record insect damage 'only' twice during the growing season:

Either **once** or **twice** during the growing season:

- **First assessment: One month after budburst** has been completed by all trees (usually, in June in Europe). It will allow testing the hypothesis that early herbivory damage is influenced by tree phenology (hypothesis: early flushed trees are more prone to damage than later ones because of herbivore concentration on the first available resource).
- **Second assessment: midsummer**, when maximal herbivore diversity is expected (Feenny, 1970) (for example leaf-miners and gall-makers are late in the season). So just before leaves start fading: estimation of total, final damage.
The problem of totally eaten leaves and fallen leaves at the end of summer that may not be accessible for survey is not a big deal since when an herbivore totally eats some leaves, the remaining leaves are likely to be severely eaten as well.
- **If only one assessment, prefer the first one to detect diversity effects and the second one to correlate with tree growth (for example)**