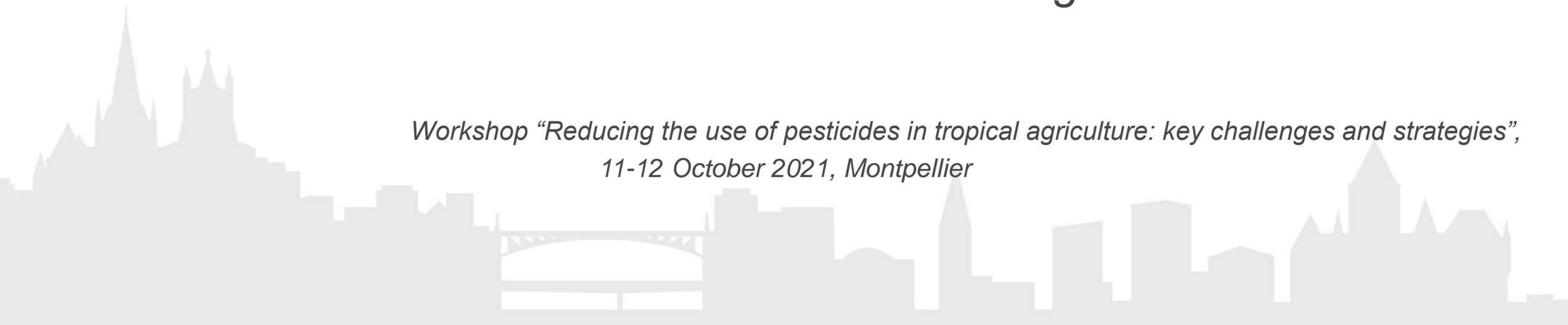


Metrics to measure and evaluate pesticide exposure

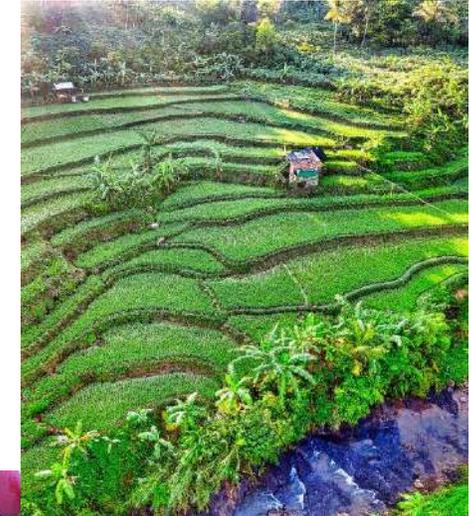
Aurélie Berthet and Alain Garrigou

*Workshop “Reducing the use of pesticides in tropical agriculture: key challenges and strategies”,
11-12 October 2021, Montpellier*



Contents

- Occupational exposure to pesticides
- Approaches to assess exposure
- Context and limitations
- Conclusion

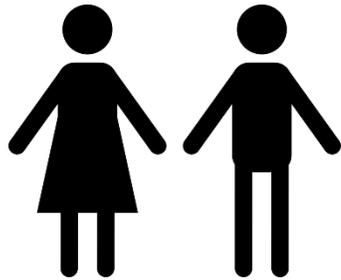


Occupational exposure to Pesticides

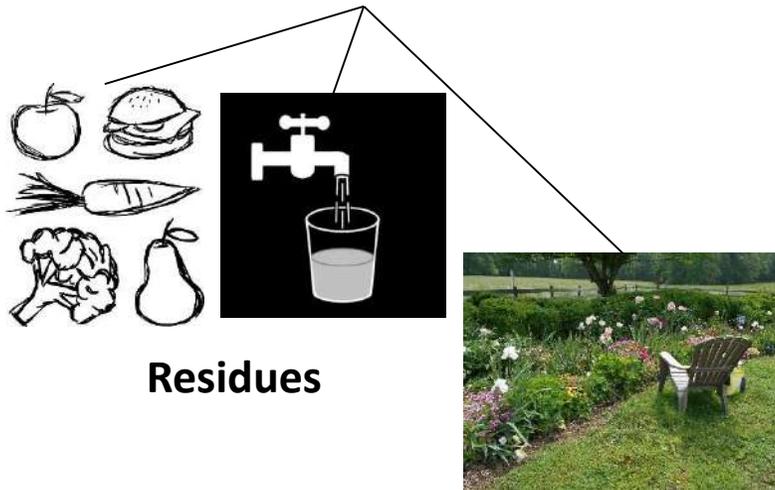


Pesticide exposure for the general population vs workers

Exposure route:
≈ 100% oral / ingestion



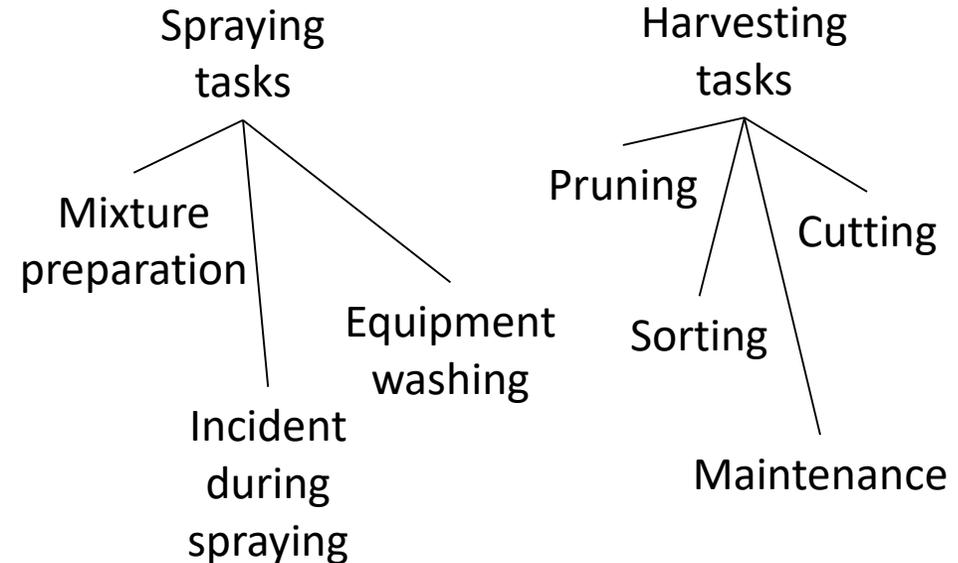
General population



Exposure route:
≈ 90% dermal
≈ 10% inhalation



Workers



Highly exposed application tasks

A) Mixture preparation



Tasks: Storage room, weighing

Products: Powder, Liquid, Granule

Formulations: Active Ingredient (AI) + solvents, etc.



Tasks: Dilution, transfer to the tank, clean the material

B) Incidents during treatments / fill several times the tank



Tasks: Unblock/
Change spray nozzles



Tasks: Fill several times
the tank depending on the
material used to spray

C) Clean the treatment material and the personal protective equipment



Tasks: Clean all the material, the tank, PPE,
remove working clothes

Highly exposed re-entry tasks

A) Crop Maintenance



Tasks : maintenance, cut, prune, sort, weed, etc.

Issues : Delay of ré-entry in the area after treatment, PPE

B) Plant sort



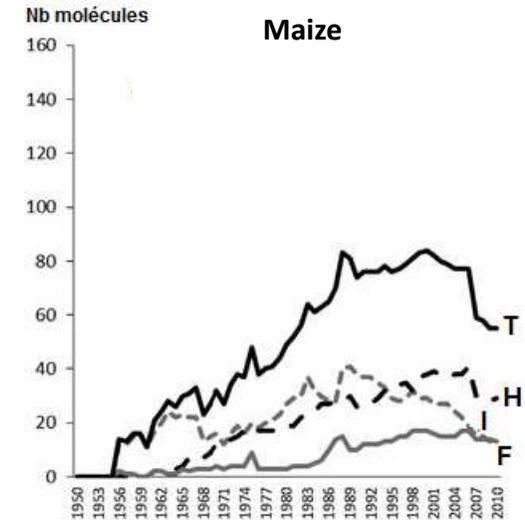
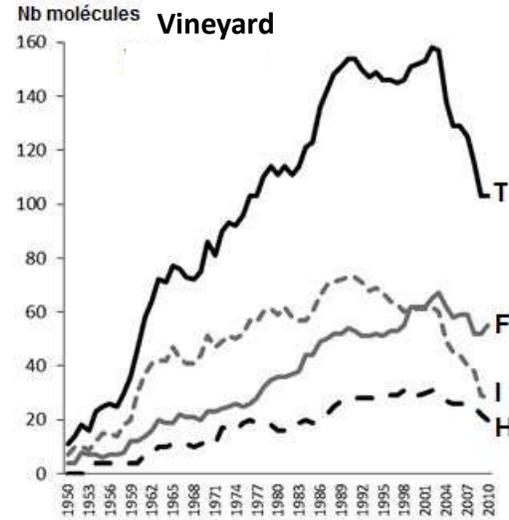
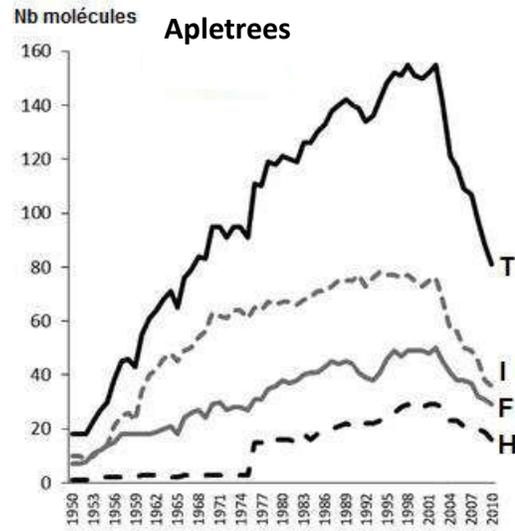
Tasks: Sort and remove weeds, verify the lack of diseases and/or pest

C) Harvesting, packaging



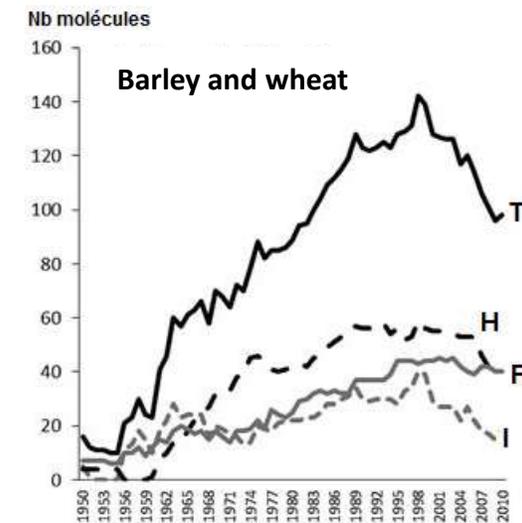
Tasks: harvest, sort, pack, etc.

Number of active substances used per year and per crop



Baldi et al. (2017) Journal of Exposure Science and Environmental Epidemiology

- Multiple and repeated exposure
- A large number of compounds
- Lifetime exposure ...?



How to assess exposure to pesticides?



Direct and indirect methods

- Estimate the amount of material in contact to the skin
- Direct methods (amount of material in contact with the skin):
 - Sampling on the skin
 - Sampling on skin substitutes
 - Tracing technique
- Indirect methods (amount of contaminant enters into the body):
 - Biomonitoring

Surface and skin sampling

✓ Surface wipe sampling

- Estimate surface contamination (potential external contamination)
- Use of solvent or impregnated material
- The customary size of the wiped surface area is a 10 cm x 10 cm square, or the surface area of a worker's palm



✓ Skin tape stripping or washing

- Use of adhesive tape or solvents
- Estimate the amount of chemicals removed from skin at the collection time (dermal load)



=> Measure an amount, but no information on permeation and absorption

Patch sampling

- Use a "dosimeter" (sorbent pad) placed on the skin or clothing to "intercept" the contaminant before it reaches the skin
- Estimate the settled amount on skin
- Assumption of similarities between the "dosimeter" and the skin

=> Measure an amount, but no information on permeation and absorption



Tracing technique

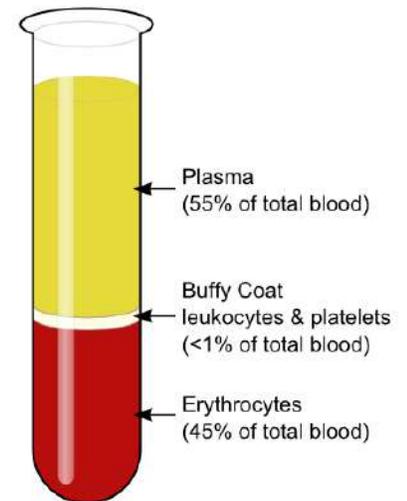
- Use of fluorescent agents
- Addition of agents before proceeding to tasks
- Qualitative data: easy to determine contaminated surfaces or body parts
- Difficult to obtain quantitative data
- Difficult to add a fluorescent tracer in some manufacturing processes

=> Observe a potential contamination, but no information on permeation and absorption



Biomonitoring

- Identify past and actual exposure
- Determine the absorbed uptake into the organism
- Required knowledge:
 - Toxicokinetics of chemicals
 - Biomarkers
- Measure of effect biomarkers (e.g., AchE)
- Not available for all chemicals
- Not indicative of the route of exposure
- Request an ethical approval

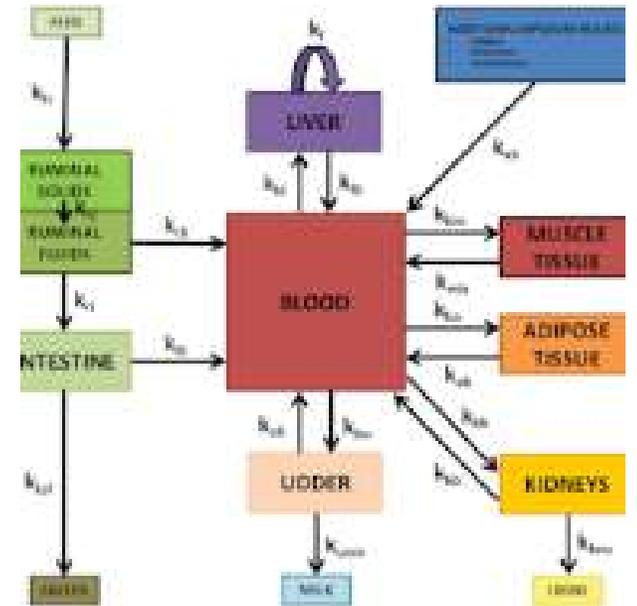


Other alternatives

Models (e.g. toxicokinetics modeling)

- Based on knowledge from biomonitoring
- Exposure scenario needed

=> For known substances only



Exposure determinants: context and limitations



Measurement strategy

- Integrate local means
 - Organization (complex)
 - Limitations using biomonitoring
 - Available instruments, locals, etc.
- Consider important parameters
 - Inter-individual variability
 - Physical effort, material
 - Temperature
 - Higher contamination
 - Specific active ingredients
 - Work conditions
 - Environmental contaminations



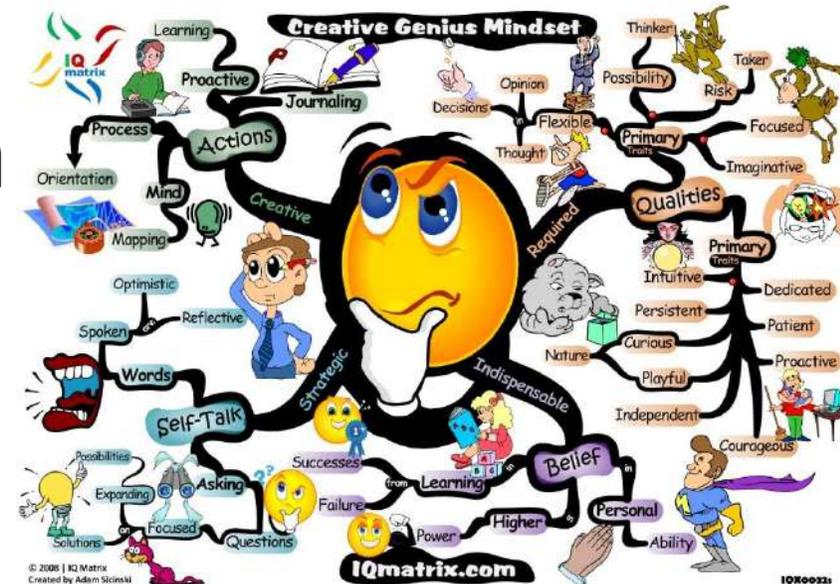
Identification of technical incidents

- Leaks
- Clogging of nozzles
- Etc.



Conclusion

- Different work conditions, means, climate, etc.
- ⇒ Select appropriate technics
- ⇒ Determine accurate exposure determinants
- ⇒ Inform on local context to define the best approach to measure exposure
- ⇒ Favor a multidisciplinary approach
- ⇒ Be creative



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Thank you for your attention

aurelie.berthet@unisante.ch

alain.garrigou@u-bordeaux.fr

