# Animal Trypanosomoses: Current Limitations and Research Imperatives

Alain Boulangé

cirad
LA RECHERCHE AGRONOMIQUE POUR LE DÉVELOPPEMENT

Alain Boulangé (CIRAD/IPR-INSP), Marisa Gonzatti (Universidad Simón Bolívar), Antoine Barreaux (CIRAD/ICIPE), Marjorie Bouchier (CEVA), Giuliano Cecchi (FAO), Marc Desquesnes (CIRAD/ENVT), Geoffrey Gimonneau (CIRAD/ISRA), Laurent Hébert (ANSES), Veerle Lejon (IRD), Liam Morrison (UoE), Luís Neves (UP/UEM), Kat Rock (UoW), Alireza Sazmand (BASU), Alexandra Shaw (UoE/AP Consultants), Philippe Solano (IRD), Sophie Thévenon (CIRAD).

37th ISCTRC meeting – Mombasa, Kenya

intertryp
Interactions
hôtes-vecteurs-parasites-environnement
dans les maladies tropicales négligées
dues aux trypanosomatidés

Institut de Recherche pour le Développement FRANCE

cirad

UNIVERSITÉ DE MONTPELLIER

*Adapted from S. Thèvenon (PCP meeting, AU-IBAR, Mombasa April 2025)*

# Main gaps in knowledge and control tools that hamper AT control



https://umr-intertryp.cirad.fr/en - sophie.thevenon@cirad.fr

# Thought about gaps in control tools

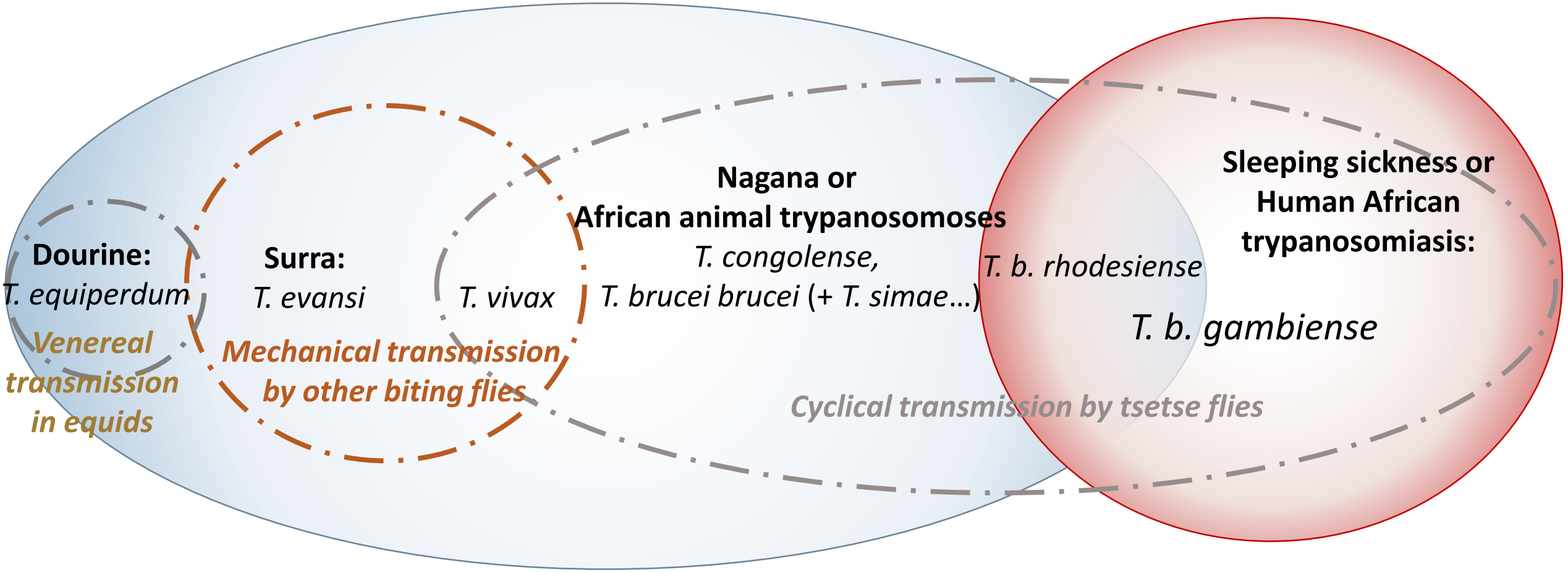
COMBAT → DISCONTOOLS https://www.discontools.eu/ → Awareness on animal diseases for funders and policy makers (EU)

**Previous EU projet ➔Research gaps for improving infectious disease control in animals**

- Invitation to update the main gaps in tools and knowledge (*Live since July*)
- Experts group of 16 people, various expertise and from Europe, Africa, Asia, South America

https://www.discontools.eu/

# African trypanosomes <=> several diseases




Several parasites - a multiplicity of mammal hosts more or less susceptible - different vectors with overlap or not

# Control tools

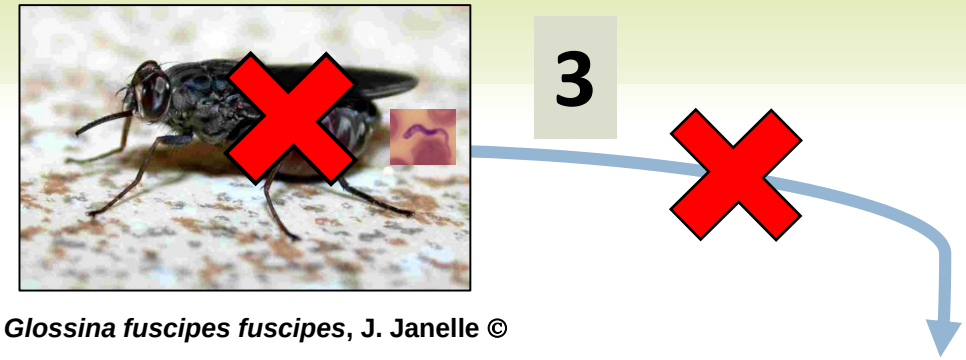
## Three pillars

Identify infected animals

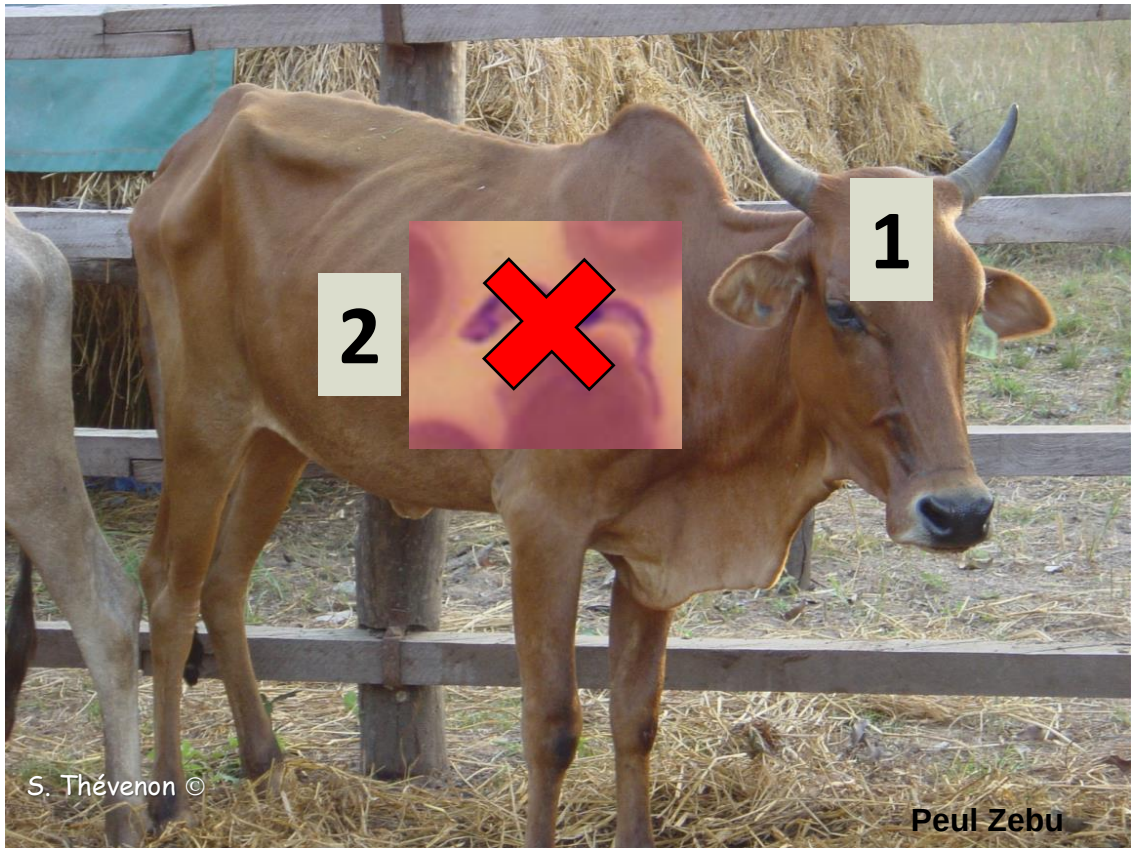
1. Diagnostics

Prevent or cure infection

2. Treatment
3. Vector control
4. Vaccine
5. Trypanotolerant breeds

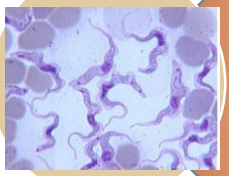



***Glossina fuscipes fuscipes*, J. Janelle ©**



# Diagnostic
# Current tools

## Gaps

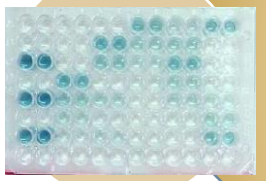


Parasitology: microscopic observation

improved by centrifugation

- Poor sensitivity
- Inability to distinguish:

*Tbb - Tbg - Tbr – Tev (Trypanozoon)*



Serology:

ELISA - whole trypanosomes lysates as antigens

ELISA - Rotat1.2 for *T. evansi* (A)

- Antibodies persistance:

active infection of not ?

- Lack of standardisation, not so easy to disseminate
- No species-level identification

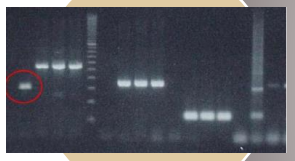


Serology : rapid tests

CATT for *T. evansi*

VerY Diag (CEVA®)

- Only for *Tev*, not at individual level
- Not easily available



Molecular Biology

PCR with pan-trypanosomes primers

or specific (Tcv, Tv, Tb s.l.)

- Many primers, not fully compared, not standardized
- Not so easy to disseminate
- Difficulty to distinguish among *Trypanozoon*

Images from the compendium of diagnosis
https://www.woah.org/nttat/Attached%20files/A16-REC-COMPENDIUM_PROTOCOLES_TRYPANO-En.pdf

# Diagnostic

# Needs and hopes






Yes => treatment

No

- **Point of care tests at individual level**
  **=> an informed treatment decision**
  Ideally: active infection based antigens on DNA/RNA
  - ✓ New lateral flow device for Ag or Ab
  - ✓ New molecular biology tools:
    assays on Sherlock technology, feasible in the field? (work on tryps, ILRI on East Cost Fever)

Sherpa

- **Serological tests for epidemiology, monitoring and surveillance => support for PCP**
  - ✓ Facilitate spread using lyophilised *in vitro*-produced Ag and other reagents
  - ✓ Recombinant antigens based on chimeras

Combat

- **Unravel genetic differences, especially within *T. brucei* clade**
  - ✓ New markers and analyses to distinguish *T. brucei/T. evansi/T. equiperdum/ T. b. gambiense* ?
  - ✓ Correct comparison of current molecular tools

✓ *Short-term*
✓ *Medium-term*
✓ *Long-term*

*Ag: antigens, Ab: antibodies*

# Treatments Current tools




- diminazene aceturate (1955) curative

isometamidium (1960s) curative and preventive

for surra: quinapyramine (1950),
melarsomine (1992)

# Gaps

- Treatment failure:
  - Sometimes not at the right dose (weight!)
  - Fake drugs
  - True resistance of the parasites
  - Ability of tryps to hide (e.g, *Tev, Tbb*)
- Toxicity depends on the host (e.g., diminazene toxic for dog, horse…)
- Food contamination (meat: waiting time several weeks)

- **More rationale usage of existing drugs**
  - ✓ Better diagnostics
  - ✓ Guidelines for better use of drugs

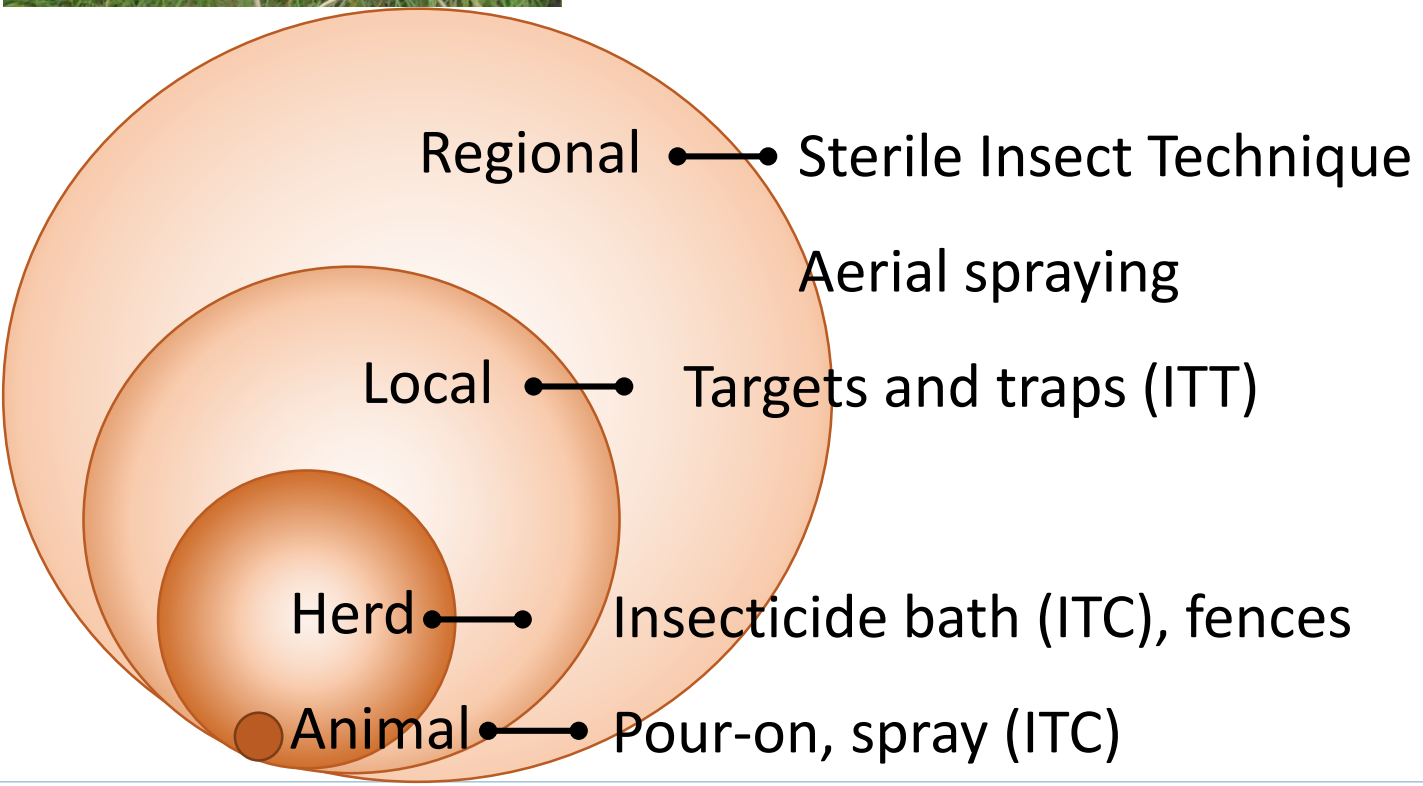
- **Document treatment failure by surveillance and monitoring: field + lab studies**
  - ✓ Distinguish misuse – fake drugs - resistance
  - ✓ Identify true resistance => work ongoing to identify markers of resistance in tryps

- **An alternative to "old" drugs**
  - ✓ Publications of new compounds efficient *in vitro* or in mice: assay in livestock and translation intro treatments?
  - ✓ Galvmed and associated research teams: potential new drug (benzoxaborole) in development to be translated into a marketable product

Combat

# Vector control
# Current tools




## Gaps

- Control or local eradication
- Resilience of tsetse flies
- Sustainability: when to stop?
- Sustainability and best cost-effective tools and strategies according to tsetse species and agro-ecological settings
- Pollution, safety issues linked to insecticides
- Biting flies: difficult due to high prolificacy and ability to develop insecticide resistances

ITT: insecticide treated target
ITC: insecticide treated cattle

# Vector control

## Needs and hopes

- **More attractive designs, adapted to different species and agro-ecological settings**
  - ✓ volatile compounds and pheromones to attract tsetse and biting flies

Combat

- **Environment-friendly control tools:**
  - ✓ Biodegradable safe traps

Combat

- **New tools for biting flies**
  - ✓ New traps and screens
  - ✓ Characterise insecticide resistance
  - ✓ Biological control

Respyre

- **Repellents for cattle:**
  - ✓ published but must be implemented

Impacting

- **Block tryps development in tsetse flies**
  - ✓ By using some microbes, paratransgenesis
- **Assess zero tsetse**
  - ✓ Monitoring and modelling

CRP AIEA

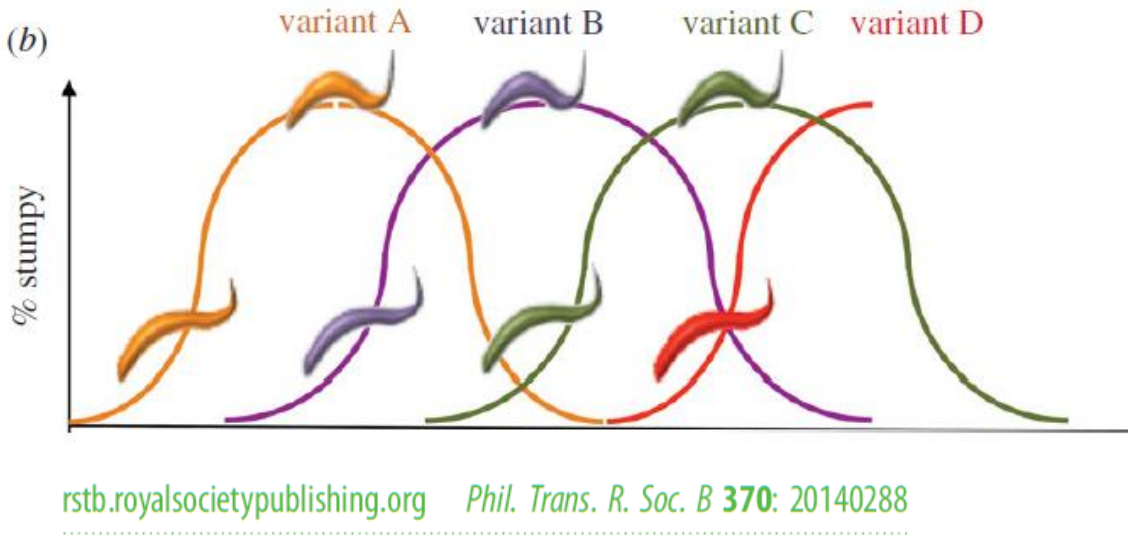
TrypaNo!3



# Vaccine

**None!**

- Tryps Ag diversity and switching
- Ability to evade and manipulate immune response

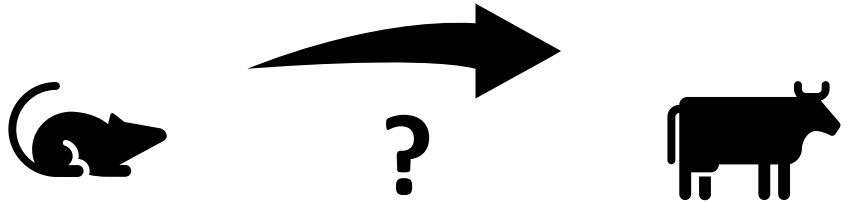



*Matthews, 2015*

**A vaccine?** would be ground-breaking, but very difficult (e.g., malaria)

- ✓Hope with a new assay V23 (*Tv*) and C69 (*Tc*) but on mice….

  => Needs to target the main host => cattle




- ✓Fundamental research on tryps and on cattle (others): interactions and immune response, new tools in biotechnologies
- ✓Advances in trypanotolerance (see after)

# Trypanotolerant breeds
# Current tools

## Gaps

Zebu (hump cattle), e.g., Zebu Fulani



Taurine (humpless), e.g., N'Dama



Susceptibility

Tolerance

Combat

Aattol

- Genetic bases: multigenic but no clear markers
- Immune response: differences but no functional hypotheses
  - Lymphocytosis in N'Dama
  - Earlier and stronger immune response in N'Dama?
  - Better antibodies response to specific trypanosome antigens?
- Metabolic response
- Hematopoiesis

- Other livestock species: less documented   ...

# Trypanotolerant breeds

# Needs and hopes

- **Improved production in tolerant breeds // improved tolerance in productive breeds**
  - ✓ Marker-assisted breeding program
    + advances in livestock genomics
    - Main issues: phenotyping!

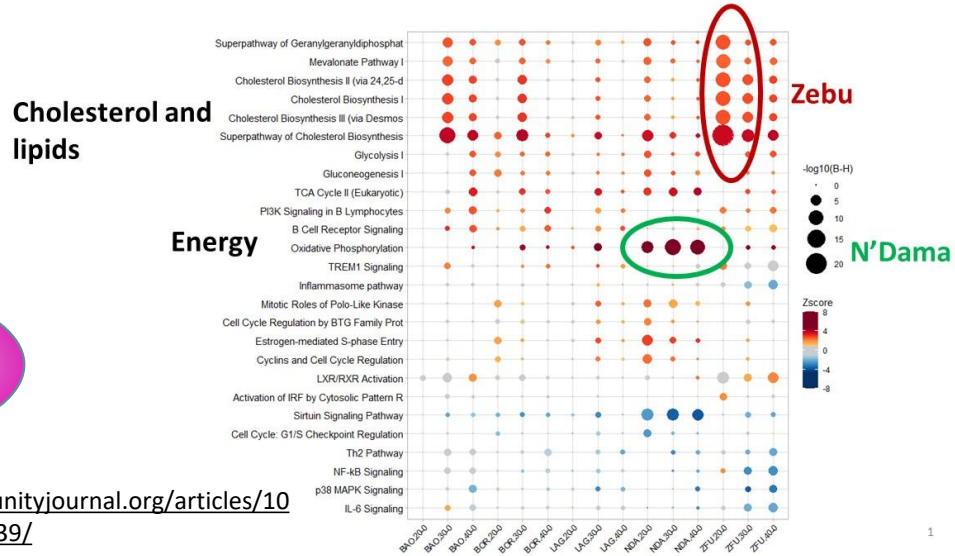
Combat




https://www.ctlgh.org/

- **Improved functional characterization to make a candidate vaccine efficient**
  - ✓ Clue on genes and immune response pathways
  - ✓ Best route and antigens for vaccination
    + Advanced in technologies to explore functions from genes to proteins and interactions
    - Cost and implementation in livestock

Cresi, Parafrap, PAHW



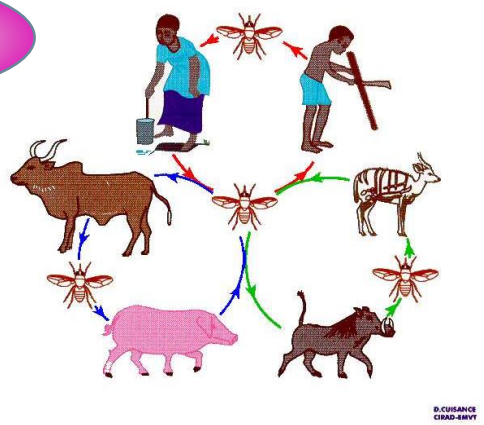

Peylhard et al 2023
https://peercommunityjournal.org/articles/10.24072/pcjournal.239/

# Additional gaps

**Complexity of epidemiological cycle**

- Potential overlapping cycles between cyclical and mechanical transmission?
- ✓ Hopes with new tools: metabacording (vectors: blood meal, parasites, microbiotes) and modelling

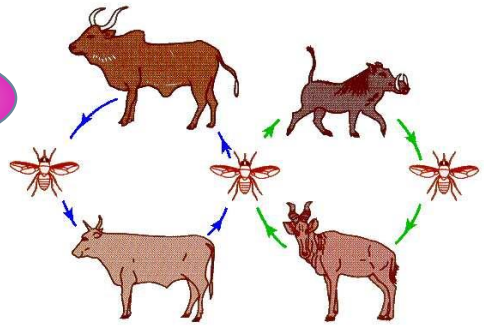
Combat



Interactions **host***tryps*vector*environment

- Why some species/breeds/individuals are more or less affected?
- Who is reservoir? Long-lasting carrier, cure or not?
- What is the impact of immunosuppression due to trypanosome infections on intercurrent diseases and response to vaccination
- Role of wildlife:  interactions in interfaces, nothing known on their immunology…

TrypaNo!3



# Additionnal gaps

Interactions host*tryps*__vector__*environment

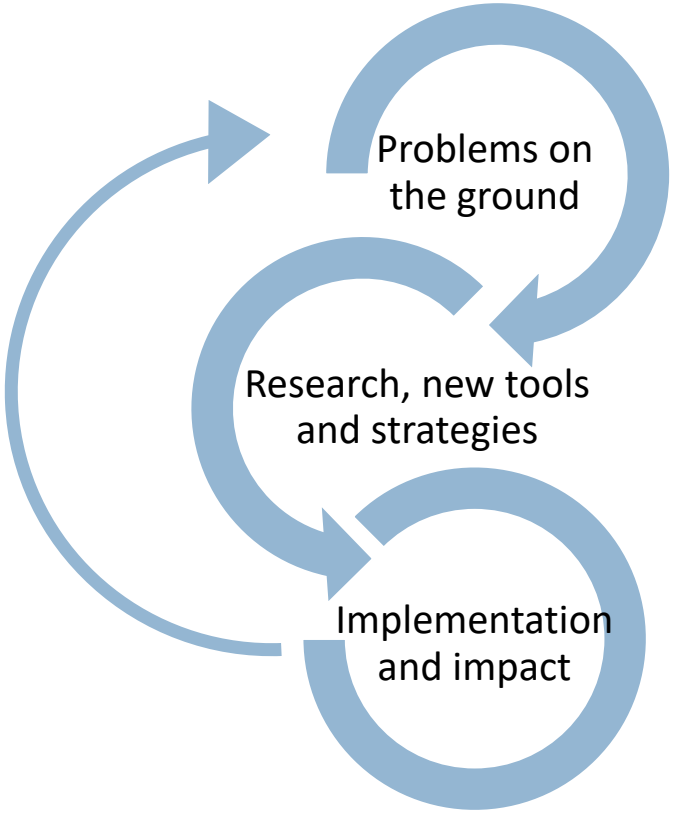
- Effect of global changes: vulnerability or way to spread? Especially for for Tabanids and *Stomoxys*
- Vector competency, vector capacity
- Resilience of flies (e.g., Gpp) despite low prolificity
- Population dynamic

More globally what we need

- Accurate estimates of morbidity and fatality rate
- Costs of the diseases
- Costs and benefits of different strategies
- Impacts of tsetse elimination
- Link THA ⇔TAA
- Share of samples to improve diagnostic “biobanks” (WOAH)
- Interactions with pastoralism, agro-ecology and stake-holders
- Support for diagnosis….

# Conclusion

- **Improved diagnostics**, treatments and vector control tools that **fit to local contexts** are required
- A **better understanding** of complex interactions between main hosts, parasites, vectors in different agro-ecological settings
- **Integrated in a larger framework** of control policies and planning
  - Investment in human resources and diagnostic facilities
  - Increased exchange of information and international, regional, national and local institutional awareness, support, and commitment




Combat

Impacting

Dimcat

# Thanks for your attention




Thanks to

AFRICAN UNION
INTERAFRICAN BUREAU FOR ANIMAL RESOURCES

COMBAT

DISCONTOOLS

**And the expert group**



UNIVERSITÉ DE MONTPELLIER

Déployer la recherche
Partager la science
Transformer l'avenir

intertryp
Interactions hôtes-vecteurs-parasites-environnement dans les maladies tropicales négligées dues aux trypanosomatidés

cirad