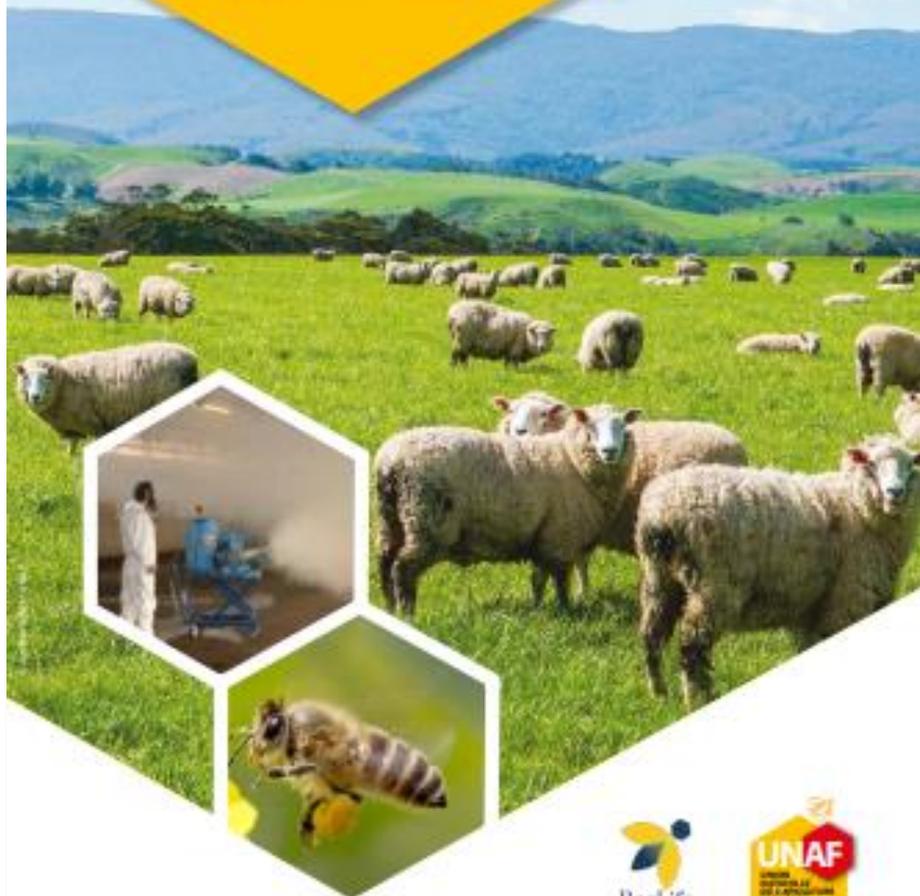


HOW PESTICIDES USED IN LIVESTOCK FARMING THREATEN BEES

VETERINARY TREATMENTS, BIOCIDAL PRODUCTS
& POLLINATING INSECTS

A UNAF REPORT
WITH THE COOPERATION OF BEELIFE EUROPEAN
BEEKEEPING COORDINATION, ENTESA AND THE FRENCH
FEDERATION OF PROFESSIONAL BEEKEEPERS



Pesticides impacts used in livestock farming on bees

Author : Vincent Zaninotto
Ecole Normale Supérieure

Supervision : Jean-Marc Bonmatin
CNRS

Speakers : Anne Furet, French
Beekeeping Union (UNAF)

Nicole Russier, French Federation
of Professional Beekeepers

INTRODUCTION

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- Winter 2010: same situation in Aveyron
- Winter 2013-2014 : again in Ariège and Pyrénées-orientales > **5000 dead hives in Ariège** and **1300 dead hives in Pyrénées orientales**



INTRODUCTION

- Strong suspicion of bee poisoning.
- Mountains regions or zones at considerable distances from crops.
- Suspicion of pesticides used to treat neighboring livestock, wich use **insecticides**.



Figure 8. Bee deaths observed in December 2008 by Ariège beekeepers @Nicole Russier

INTRODUCTION

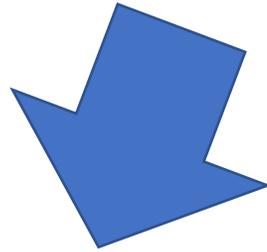
In 2018, UNAF commissioned a report aiming at:

- reviewing the current state of play of insecticides used in livestock
- assessing the risks for beekeeping activities
- assessing the ability of the regulation to protect bees from pesticides in livestock

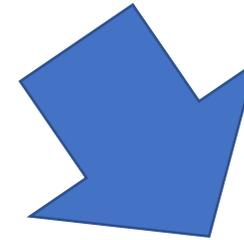


Figure 8. Bee deaths observed in December 2008 by Ariège beekeepers @Nicole Russier

ACTIVE INGREDIENTS AND FORMULATIONS

A yellow banner at the top of the slide features a faint, stylized chemical structure in orange and red lines, including a ring and various bonds.

**Veterinary
antiparasitic
treatments**



**Surface
biocides**

ACTIVE INGREDIENTS AND FORMULATIONS

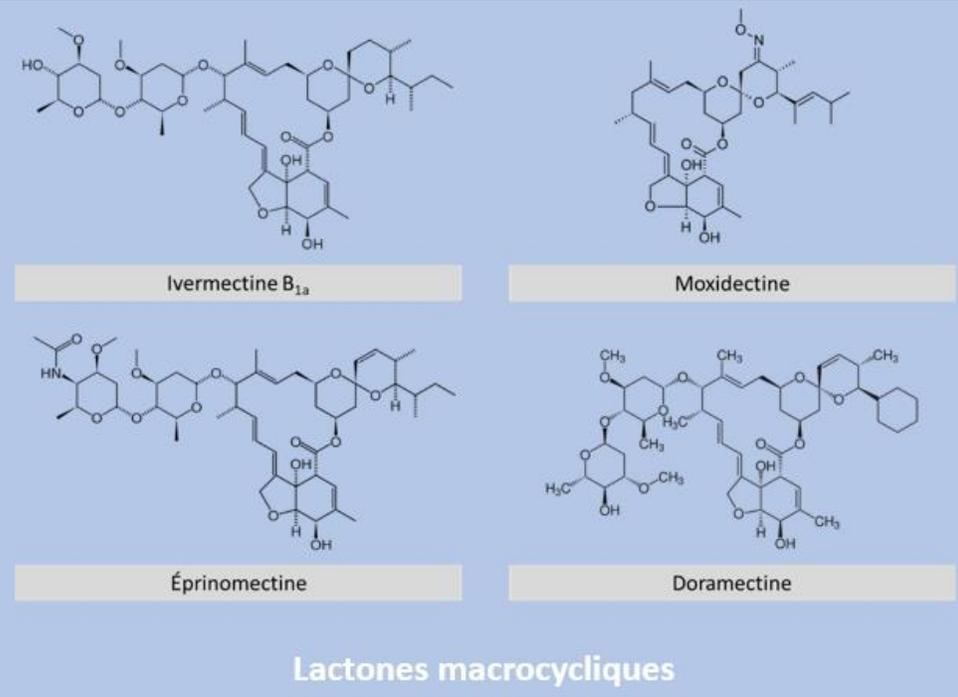
Veterinary antiparasitic treatments

- **Authorized drugs:**

20 insecticides, 81 endectocides, 75 anthelmintiques

- **Main families of neurotoxic insecticides**

Macrocyclic lactones (ivermectine, moxidectine, doramectine, éprinomectine)



ACTIVE INGREDIENTS AND FORMULATIONS

Veterinary antiparasitic treatments

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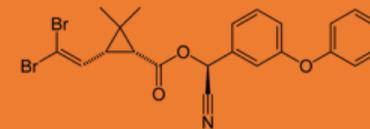
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- **Main families of neurotoxic insecticides**

Macrocyclic lactones (ivermectine, moxidectine, doramectine, éprinomectine)

Pyrethrinoids (deltamethrin, cypermethrin)

Organophosphates (phoxime et dimpylate)

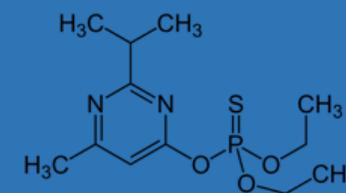


Deltaméthrine

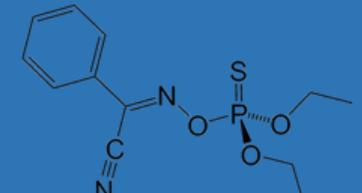


Cyperméthrine

Pyréthriñoïdes



Dimpylate



Phoxime

Organophosphorés

ACTIVE INGREDIENTS AND FORMULATIONS

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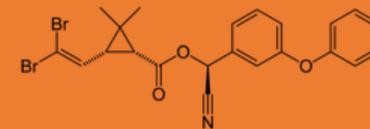
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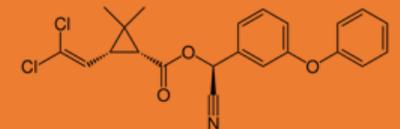
Pyrethrinoids (deltamethrin, cypermethrin)

Organophosphates (phoxime et dimpylate)

- **Authorization process at national level with an assesment by Anses (French agency)**

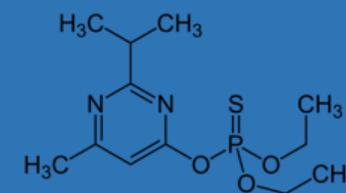


Deltaméthrine

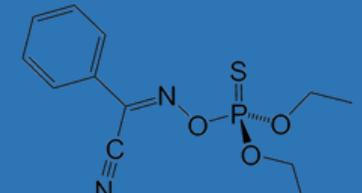


Cyperméthrine

Pyréthrinoïdes



Dimpylate



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Organophosphorés

ACTIVE INGREDIENTS AND FORMULATIONS

Surface Biocides

- **Active substances and formulations on the market**

As of 2018

84 authorized products autorisés (French authorization)
(deltamethrin, imidacloprid, fipronil above all)

A lot more on the market:

Deltamethrin (133) ; cypermethrin (181); permethrin (>500) ; fipronil (10) ; imidacloprid (44) ; clothianidin (5) ; thiamethoxam (2) ; dinotéfuran (1)

- **Transitional regulatory period**

Authorization of substances at european level

Expecting for the assessment of substances already on the market in 2000



Figure 5 : Biocidal treatment of an empty barn by thermonebulisation. The insecticide solution is sprayed in fine droplets which ensures a wide aerial distribution of the substance [26].

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Figure 5 : Biocidal treatment of an empty barn by thermonebulisation. The insecticide solution is sprayed in fine droplets which ensures a wide aerial distribution of the substance [26].

DISTRIBUTION AND USES

The background of the top section of the slide features a close-up, slightly blurred image of several orange slices. The slices are arranged in a way that shows their characteristic segments and the white pith. The lighting is warm, highlighting the vibrant orange color of the fruit.

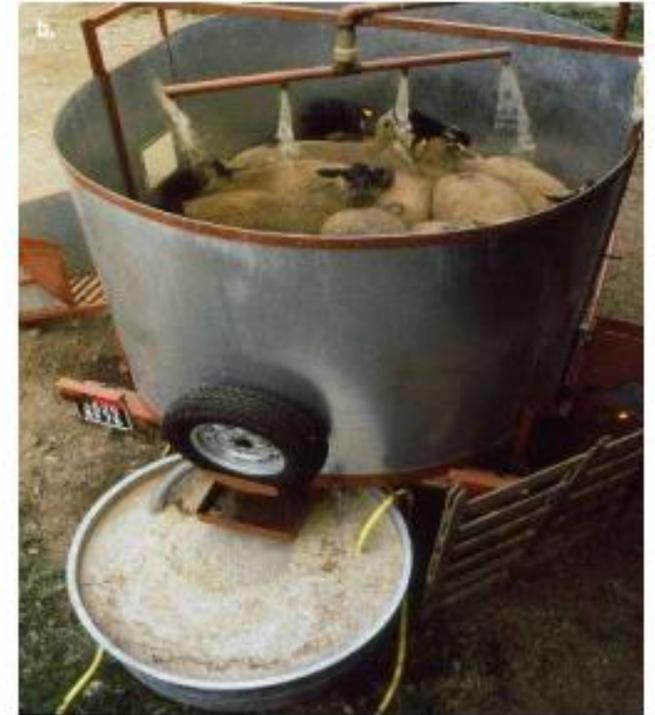
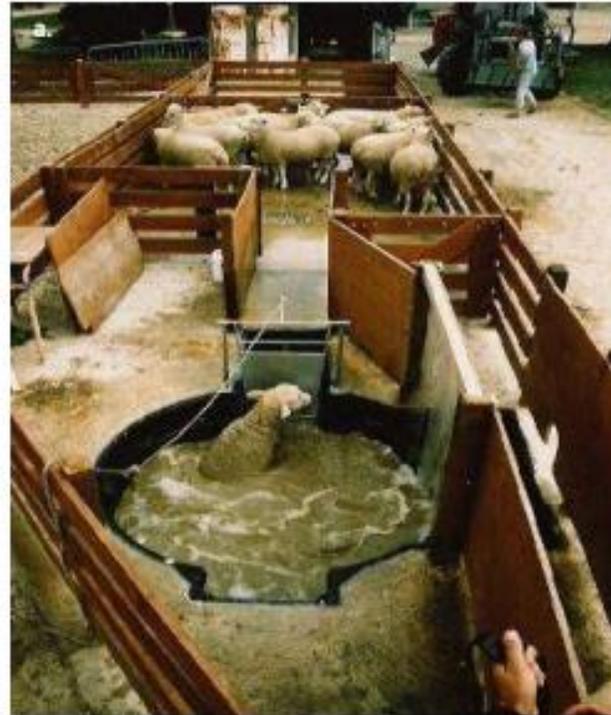
DISTRIBUTION AND USES

Ways of application

1. Veterinary treatments

Sheep: bathing, spraying and extrem-pressure showers, more rarely injection or oral intake...

Cattle: pour-on (application on the back line), earplugs, subcutaneous injections...



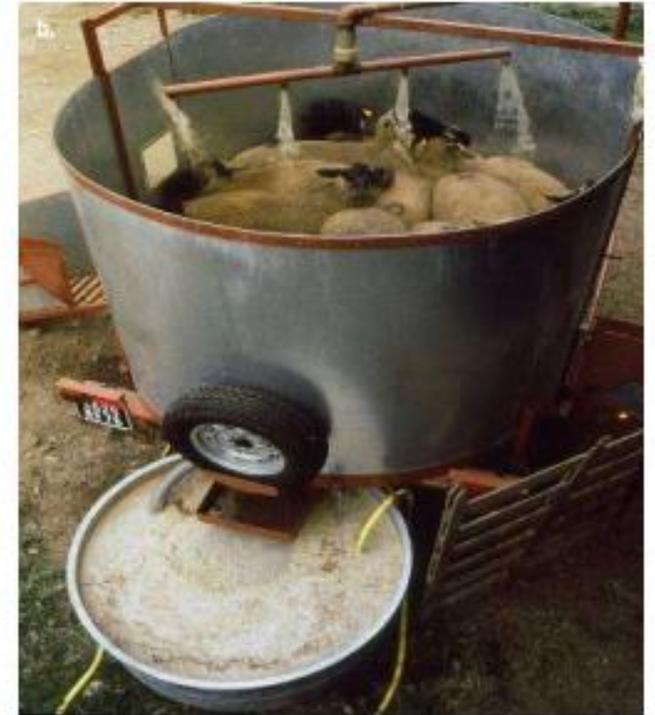
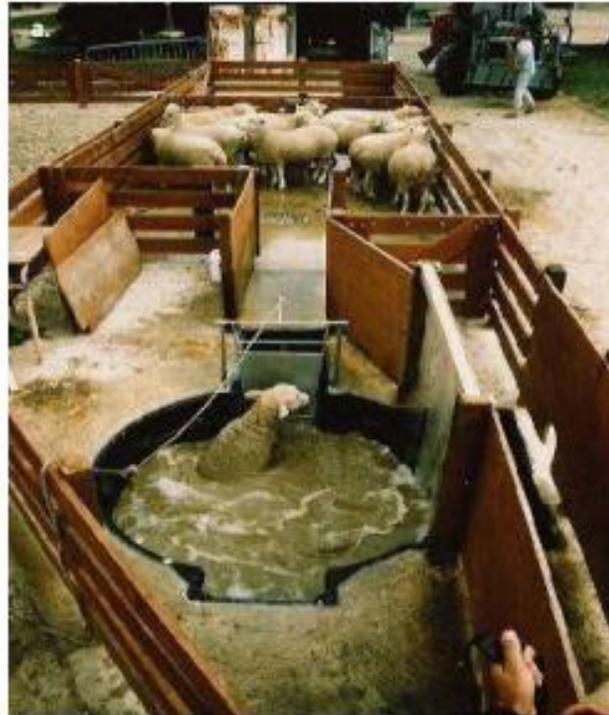
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DISTRIBUTION AND USES

Ways of application

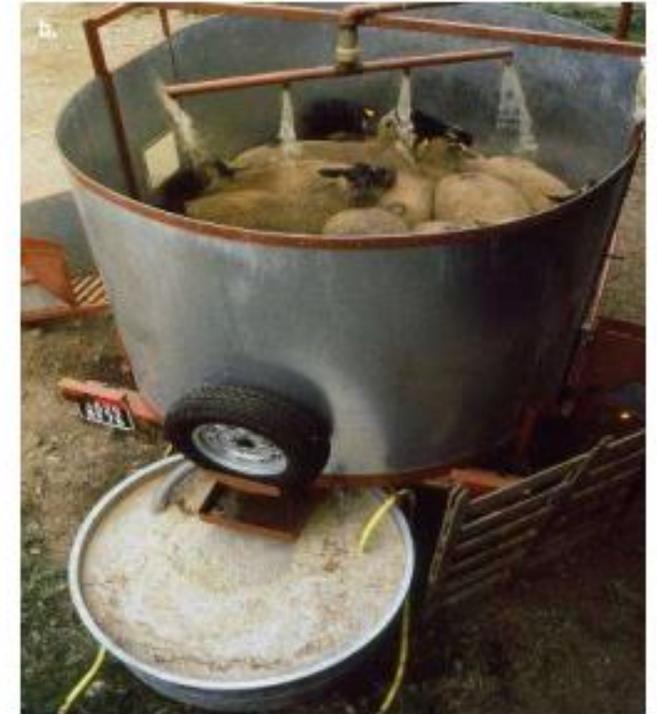
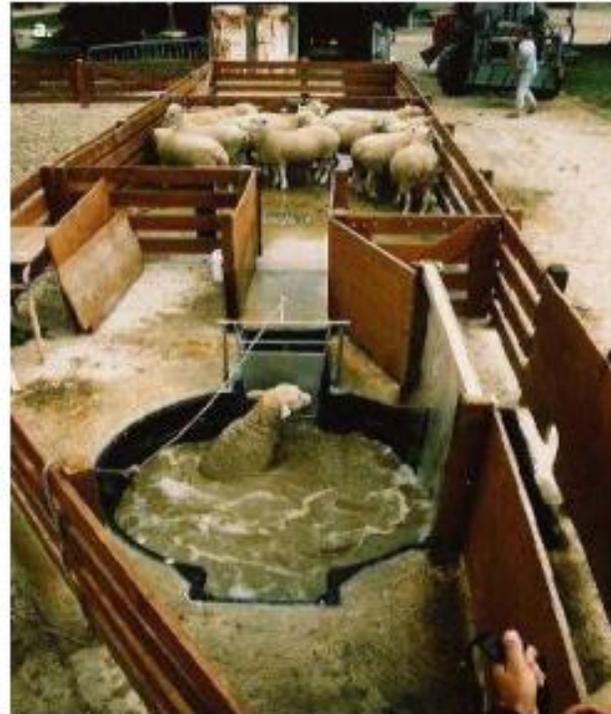
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2. Biocides

Spraying, nebulisation, traps...



DISTRIBUTION AND USES

Epizootics and vector controle

- **Example of Bluetongue virus**

Insecticide treatment is required : treatment of animals, livestock buildings and surroundings : Directive 2000/75 article 4 d) iii

Questions about the efficiency of this measures (AFSSA, 2009)

These treatments have caused bee hives mortalities.

EXPOSURE AND ECOTOXICITY



The background of the top section is a photograph of a rural landscape. In the foreground, there is a wooden fence. Behind the fence, several sheep are grazing in a field. The overall color palette is warm, dominated by oranges, yellows, and browns, suggesting a sunset or sunrise setting.

EXPOSURE AND ECOTOXICITY

Fate of insecticides used in livestock farming

EXPOSURE AND ECOTOXICITY

Fate of insecticides used in livestock farming

- Excretion :

- Ex. 1 bolus of intra-ruminal ivermectin > intense fecal elimination lasting + than 120 days and ivermectin is detected in excretion
- Pour-on with pyrethrinoids can lead to substances still active in urine and faeces



EXPOSURE AND ECOTOXICITY

Fate of insecticides used in livestock farming

- More direct environmental contamination :

- Bathing, spraying on animals
 - >> insecticide flows
 - >> collection and treatments of effluents not systematic
- Pour-on : escape of ecotoxic substance with flows
- Biocides on the external environment of livestock farming >> significant pollution for ecosystems

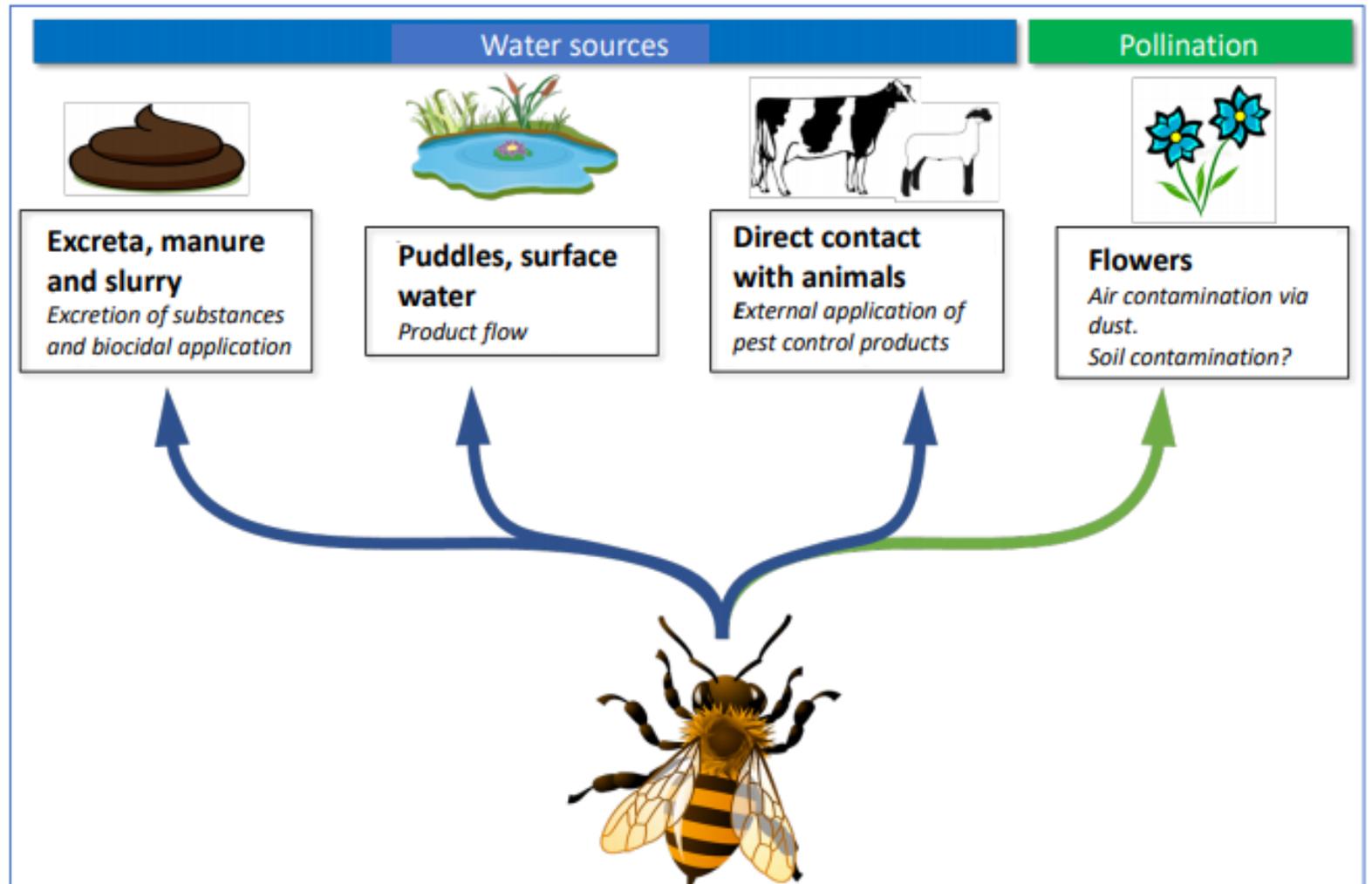
>> SOIL AND WATER CONTAMINATION

SUBSTANCE	METABOLISATION	SOLUBILITY	MOBILITY	DEGRADATION
Ivermectine	Most of the dose is excreted unchanged in the faeces [77]. Main metabolites: 24-OH-H2B1a, 24-OH-H2B1a-MS, 24-OH-H2B1b [78]	Not very soluble 4 mg/L [15]	Low mobility: Clay soil $K_{oc}=12600$ Silty soil $K_{oc}=15700$ [79]	Long to very long HL _{mix soil-feces summer} = 7-14 days HL _{mix soil-feces winter} = 9 1-217 days [79] HL _{sandy soil} = 14-28 days HL _{sol argileux} = 28-56 days [79]
Cypermethrin	Elimination is done by faecal means [71]. Main metabolites: cis and trans (DCVA), 3-phenoxybenzoic acid (3PBA) & 3-(4'-hydroxy-phenoxy) benzoic acid (4OH3PBA) [80]	Very little soluble 0.004 mg/L [80]	Very low mobility $K_{oc}=20\ 800-503\ 000$ [80]	Long to very long HL from 4 to 56 days in soils [80] HL _{hydrolyse} = 179 days [79]
Deltamethrin	4D-HO-deltamethrine & Decamethrinic acid [69]	Very little soluble 0,0002 mg/L [69]	Very low mobility $K_{oc}=460\ 000 - 16\ 300\ 000$ [79]	Long HL _{aerobie} =21-25 days HL _{anaerobie} =31-36 days [79]
Dimpylate	2-Isopropyl-4-methyl-6-hydroxypyrimidine & Diazoxon (still active cholinesterase inhibitor) [69]	Not very soluble 60 mg/L [69]	Average mobility $K_{oc}=1580$ [69]	Longue HL _{hydrolyse} =138 days - HL _{aerobie} =40 days, HL _{anaerobie} =16 days [69]
Phoxime		Not very soluble 1,5 mg/L [69]	High mobility $K_{oc}=686$ [69]	Moderate HL _{hydrolyse} =7,2 days HL _{aerobie} =6 days [69]
Amitraze	2,4-dimethylphenyl formamide (2,4-DMPF) & 2,4-dimethyl aniline (2,4 DMA) [69]	Très peu soluble 0,0094 mg/L [69]	High mobility $K_{oc}=951$ [69]	Long HL _{hydrolyse} =67 days [69]

Table 1 : Fate of insecticidal substances used in livestock production after metabolization and release into the environment (HL: Half-life)

EXPOSURE AND ECOTOXICITY

Potential routes of exposure and toxicity to bees



ACTIVE INGREDIENT	ACUTE TOXICITY	CHRONIC TOXICITY	SUBLETHAL EFFECTS
Ivermectin	<p>Very high CL50=570 ng/mL (oral, 24h) [109] DL50=0,002µg/bee (topical) [110] DL50=0,011 µg/bee (abamectine, oral) [111]</p>		Reduced long-term olfactory memory [112]
Cyperméthrin	<p>High DL50= 110-560 ng/bee (oral) [32] DL50=23-130 ng/bee (oral) [32]</p>	Demonstrated [113]	
Deltamethrin	<p>Very high DL50=1,5 ng/bee (topical) [22] [32] DL50=50,65 ng/bee (topical) [114] DL50=850 ng/bee (oral 24h) [111] DL50=620 ng/bee (oral 48h) [115] Suspected synergy with organophosphates [116]</p>	Demonstrated [117]	<p>Disorientation [118] Reducing fertility and slowing development [119] Disruption of learning abilities [120]</p>
Dimpylate	<p>High DL50=200 ng/bee (oral) [32] DL50=52-233 ng/bee (topical) [121] [122]</p>		
Phoxime	Mentioned but not quantified [13]		
Amitraze	<p>Moderate DL50=14830 ng/bee (oral) [123] DL50=3660 ng/bee (topical) [124]</p>		Damages heart function and resistance to viral infections [125]

EXPOSURE AND ECOTOXICITY



By simply comparing the quantities excreted and the toxicity:

- *Ex. cypermethrin with pour-on, a treated cow ⇔ enough to kill **1 million of bees** ⇔ about 25 hives (from Virlouv et al. 2003 results)*
- *Ex. ivermectine subcutaneous, a treated cow ⇔ enough to kill **92 millions of bees** ⇔ about 2300 hives (from Tremblay & Wratten 2003 results)*

EXPOSURE AND ECOTOXICITY

Risk assessment and regulation

Current assessments are insufficient and do not take into account the bee risk

- Guidelines for the evaluation of **veterinary products**: no mention of bees, but mention of coprophagous risks
- Guidelines for the evaluation of **biocidal products**: "no method is available for biocides on how to perform the risk assessment for bees and non-target arthropods."

SUMMARY

- Insecticides used in livestock farming for veterinary or biocidal uses **can disseminate in the environment**
- These insecticides are **very toxic to bees**
- **Bees can be exposed to these insecticides:**
 1. Water collection : excreta, manure, slurry, puddles, surface water, direct contact with animals
 2. Pollen and nectar collection : air contamination via dusts and soil contamination
- **Today, this risk is poorly considered :**
 1. In the assessment before the authorization
 2. In the practices

OUR REQUESTS

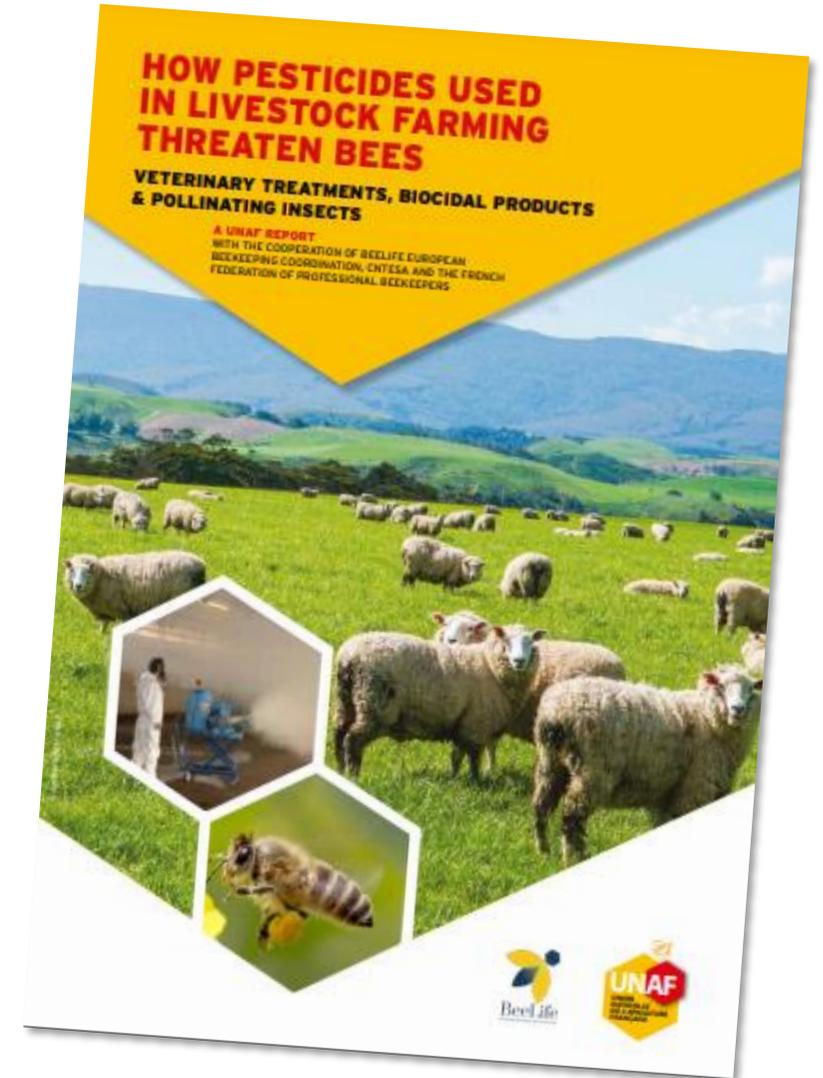
- Real consideration of bees in **risk assessments**
- Reinforcement of **scientific knowledge** in terms of bee exposure mechanisms and epidemiological studies
- **Better reasoned vector control**
- Better **transparency of the veterinary medicinal products and biocidal products markets**
- Raising the **awareness of veterinarians** of ecotoxicity issues
- The development of **alternative practices** to the most toxic insecticides

WHAT HAPPENED SINCE THE PUBLICATION OF THE REPORT ?

- Awareness among beekeepers of this potential source of contamination

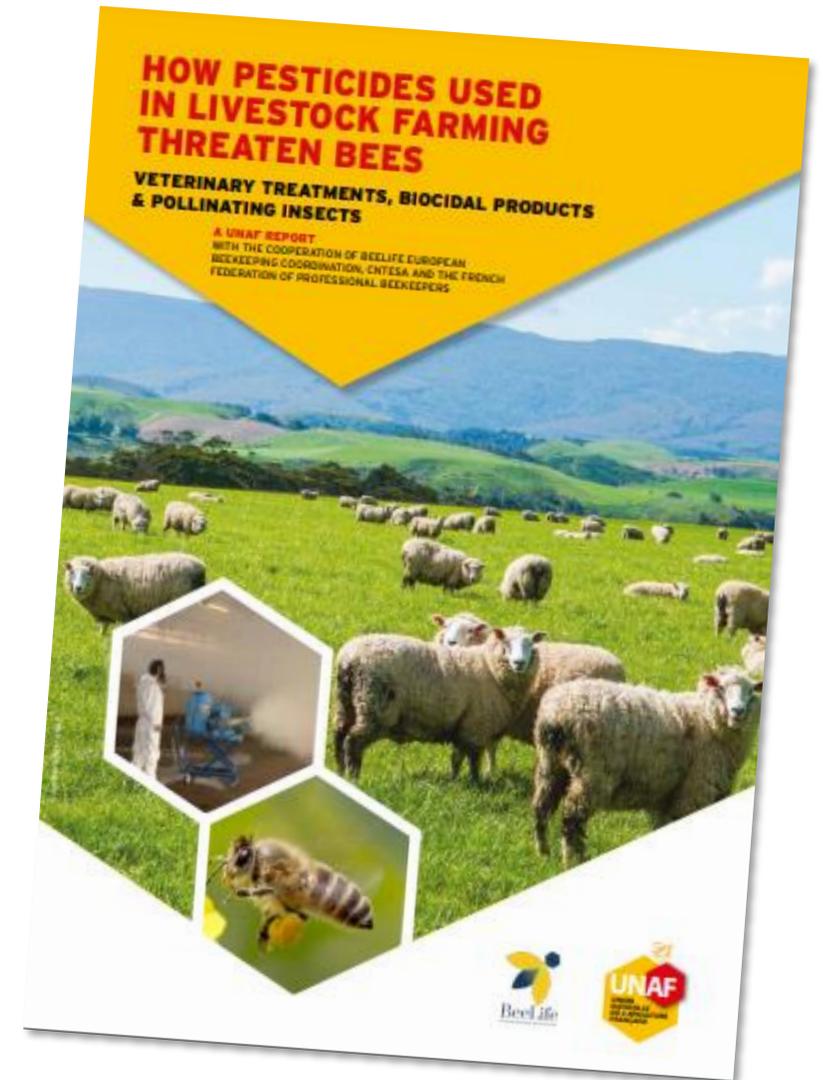
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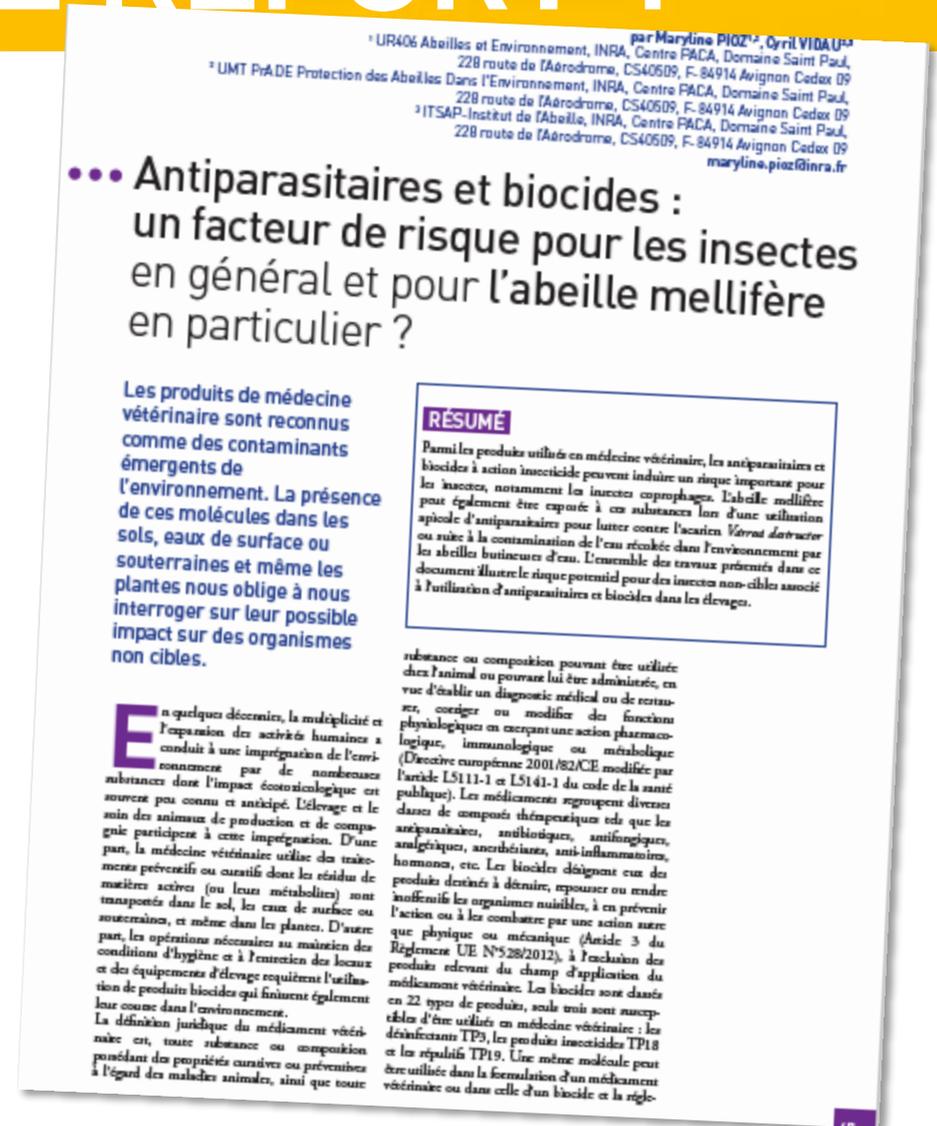
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Original Articles

Ivermectin dissipation and movement from feces to soil under field conditions

Lucía Emilia Iglesias ✉, Carlos Saumell, Federica Sagüés, Juan Manuel Sallovitz & Adrián Luis Lifschitz

Pages 42-48 | Received 27 Apr 2017, Accepted 22 Aug 2017, Published online: 26 Sep 2017

Download citation

<https://doi.org/10.1080/03601234.2017.1371554>

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Pesticides Used on Beef Cattle Feed Yards Are Aerially Transported into the Environment Via Particulate Matter

Eric M. Peterson, Frank B. Green, and Philip N. Smith*

Cite this: *Environ. Sci. Technol.* 2020, 54, 20, 13008–13015

Publication Date: September 16, 2020

<https://doi.org/10.1021/acs.est.0c03603>

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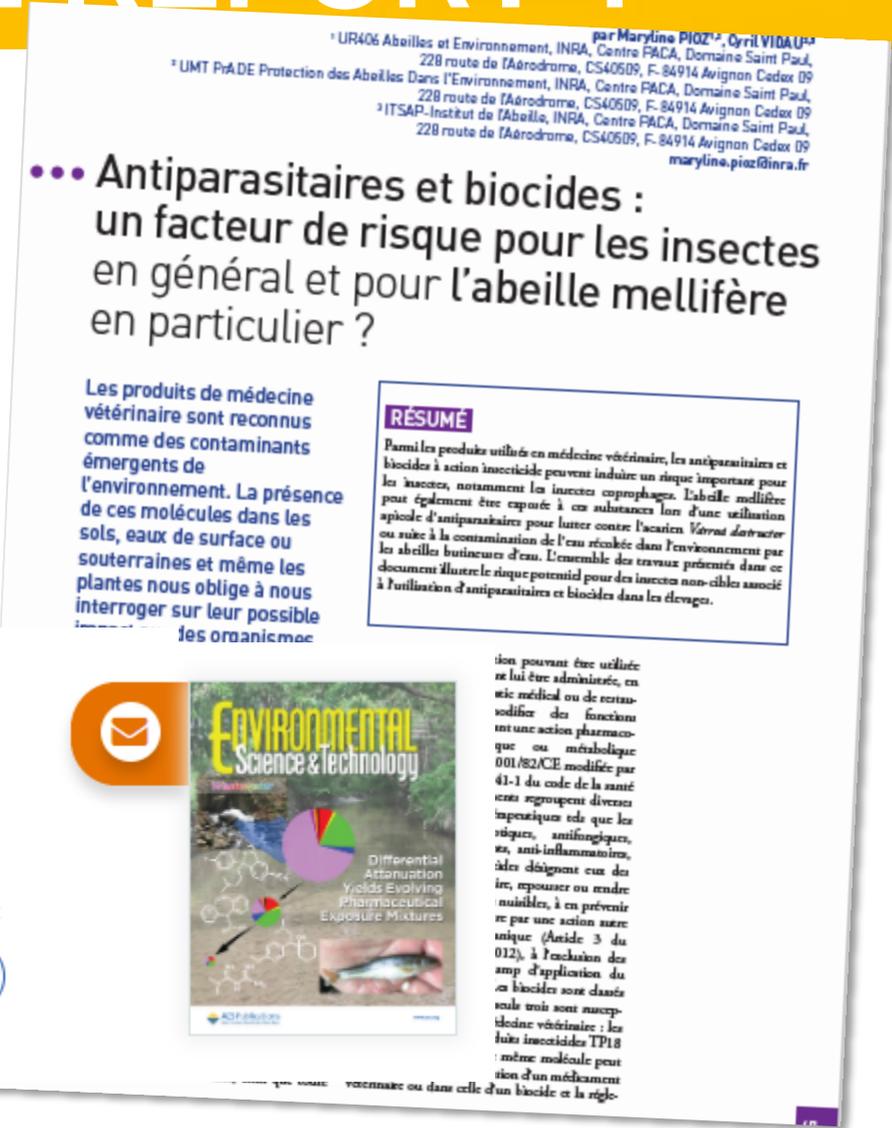
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nt une action pharmaco-
que ou métabolique
001/82/CEE modifiée par
41-1 du code de la santé
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tibles vétérinaire : les
lits insecticides TP18
même molécule peut
sion d'un médicament
on d'un biocide et la régle-



THANK YOU FOR YOUR ATTENTION

Anne FURET, UNAF: anne.furet@unaf-apiculture.info

Nicole RUSSIER, FFAP : nrussier@wanadoo.fr

Read the report in English: <https://bit.ly/3kMT3k3>

Read the report in French: <https://bit.ly/37XPZhh>

