EFSA's risk assessments on vector-borne diseases:
an example of assessing the risk of mosquito-borne diseases

Sofie Dhollander
Animal and Plant Health Unit

18/10/2018 Perugia, ECVPH

efsa
European Food Safety Authority

Outline

- Vector-borne diseases in EFSA
- Fever and Mintrisk
- Example of risk assessment of mosquito-borne diseases in the EU
- Future challenges

2

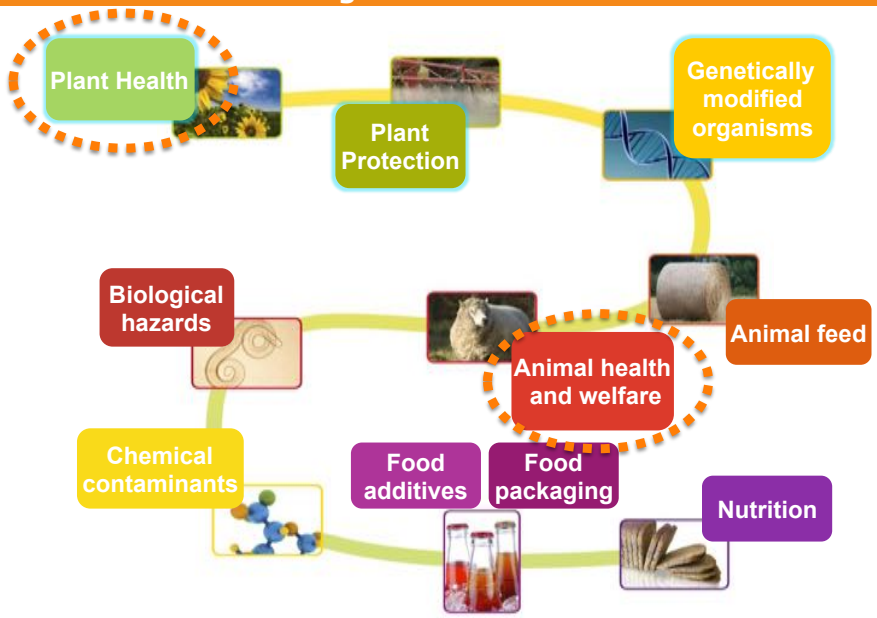
VECTOR-BORNE DISEASES IN EFSA

3

How does it work?

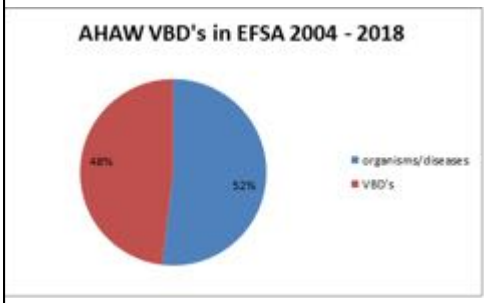
4

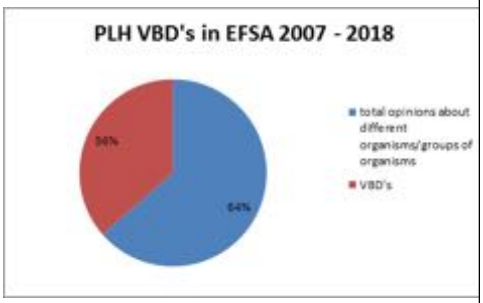
EFSA's Panels dealing with vector-borne diseses



5

Pathogens dealt with in in ALPHA outputs





6

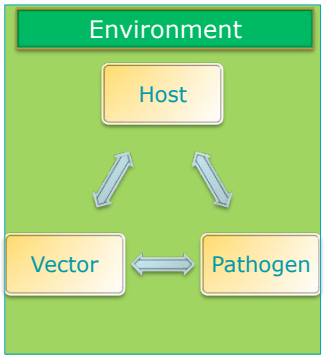
ALPHA: One-health approach

- Climate change, social and political instability, changes in landscape : potential drivers for their introduction
- Complex interaction between host, pathogen and environment> complex diseases to prevent and control

-**Human VBD's**: 17% of the estimated global burden of all infectious diseases

-**Animals VBD:** bluetongue virus: ~1.4B $USD in economic losses in France in 2007 alone (Tabachnik et al. 2008)

-**Plant VBD:** citrus tristeza virus (an aphid-borne disease) has killed tens of millions of citrus trees worldwide, and currently threatens California orange crops



AGENTS/PATHOGENS

ANIMALS AND/OR HUMANS

Viruses: e.g: Dengue fever virus, Rift Valley fever virus, Japanese encephalitis virus, West Nile virus, Crimean-Congo hemorrhagic fever virus, etc

Bacteria: e.g.: *Borrelia burgdorferi* (bacteria causing Lyme disease) or *Yersinia pestis* (causing plague)

Protozoa: e.g.: *Trypanosoma brucei gambiense* (sleeping disease) *or L. infanctum* (leishmaniosis), *Plasmodium spp.* (malaria)

PLANTS

Viruses: e.g: Banana bunchy top virus BBTV, Arabis mosaic virus, Raspberry ringspot virus (more than 200 plant viruses transmitted by a single whitefly, *Bemisia tabaci*)

Viroids (eg Pospiviroids transmission by aphids and bumble bees)

Bacteria: e.g.: *Xylella fastidiosa* causing Pierce's disease by xylem-sap feeder insects

Phytoplasma eg. eg grapevine Flavescence dorée by leafhoppers

Nematodes: e.g.:*Bursaphelenchus xylophilus* (vectored by *Monochamus spp.* insect)

Fungi:*Gibberella circinata, Monilinia fructicola, Bretziella fagacearum* by beetles

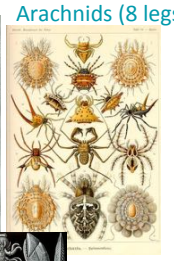
VECTORS

ANIMALS AND/OR HUMANS

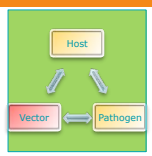
Vector species: the largest part are blood-sucking arthropods

Insects (6 legs)

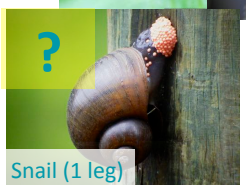
Arachnids (8 legs)



Other creepy stuff



Insects (6 legs)

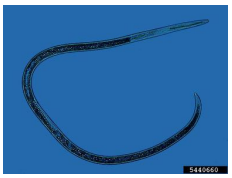


Snail (1 leg)

PLANTS

Arachnids (8 legs)

Nematodes (no legs…)

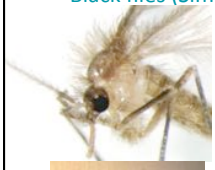


And…some fungi transmitting viruses
(like *Synchytrium endobioticum*)

INSECT VECTORS

ANIMALS AND/OR HUMANS

- Mosquitoes (Culicidae)
- Culicoids (*Culicoides* spp.)
- Sandflies (*Phlebotomus* spp.)
- Black flies (Simulidae)



PLANTS

- Aphids
- Thrips
- Mealybugs/scale insects
- Flies/whiteflies
- Beetles
- Leafhoppers/treehoppers/planthoppers
- Moths

ARACHNID VECTORS

ANIMALS AND/OR HUMANS

- Mites
- Ticks

PLANTS

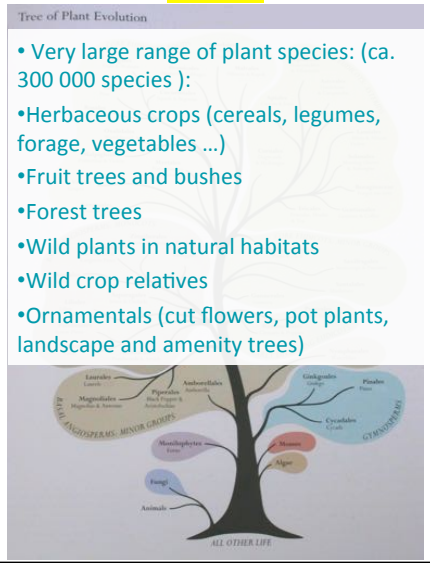
- Mites

HOSTS

ANIMALS AND/OR HUMANS

- Large range of animals (pets, livestock, wildlife, e.g. rodents, birds…)
- Humans
- Both animals and humans (=zoonotic VBD)

PLANTS

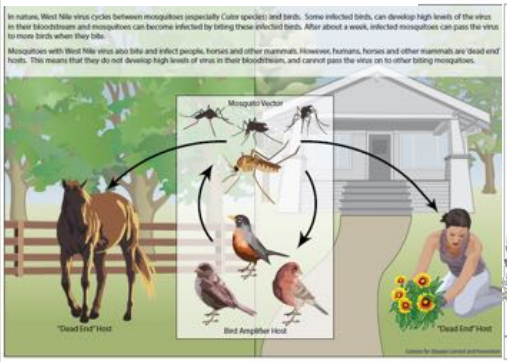


- Very large range of plant species: (ca. 300 000 species):
- Herbaceous crops (cereals, legumes, forage, vegetables …)
- Fruit trees and bushes
- Forest trees
- Wild plants in natural habitats
- Wild crop relatives
- Ornamentals (cut flowers, pot plants, landscape and amenity trees)

LIFE CYCLE

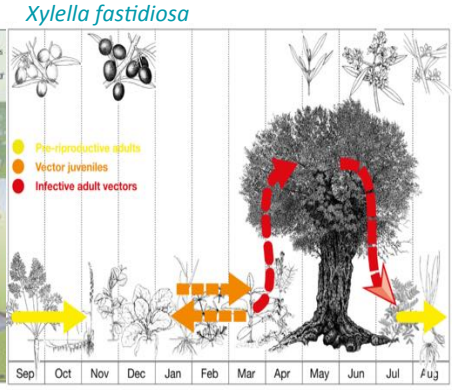
ANIMALS AND/OR HUMANS

West Nile virus



PLANTS

Xylella fastidiosa



Mandates and terms of reference

ANIMALS AND/OR HUMANS

PLANTS

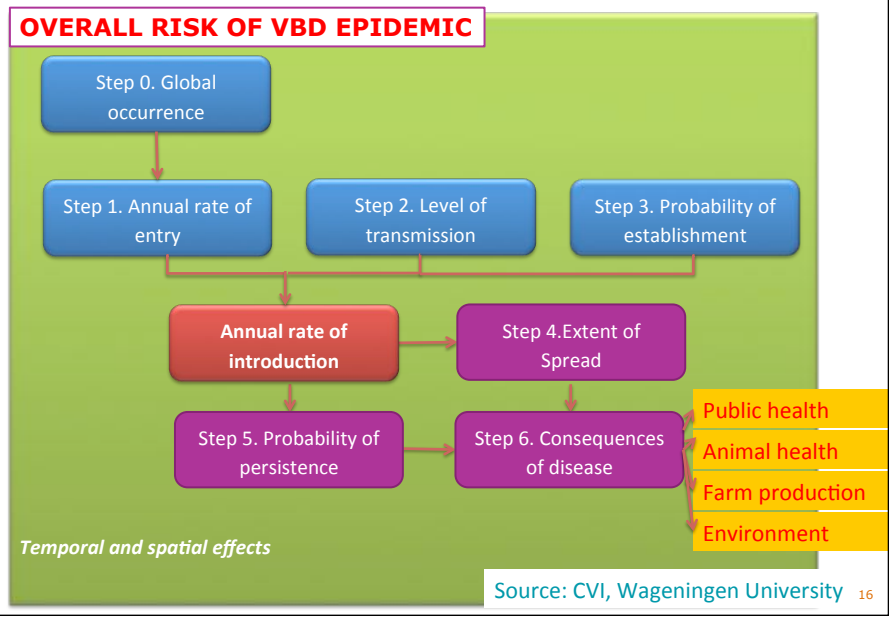
- Global occurrence?
- Probability of introduction?
- Extent of spread?
- Probability of endemicity?
- Impact of introduction and spread?
- Prevention and control

14

- **FEVER and MINTRISK**

15

FEVER: FRAMEWORK FOR EMERGING VECTOR-BORNE DISEASES RISK



Source: CVI, Wageningen University

16

METHOD FOR INTEGRATED RISK ASSESSMENTS

https://www.wecr.wur.nl/mintrisk/

Qualitative or quantitative data input and output

17

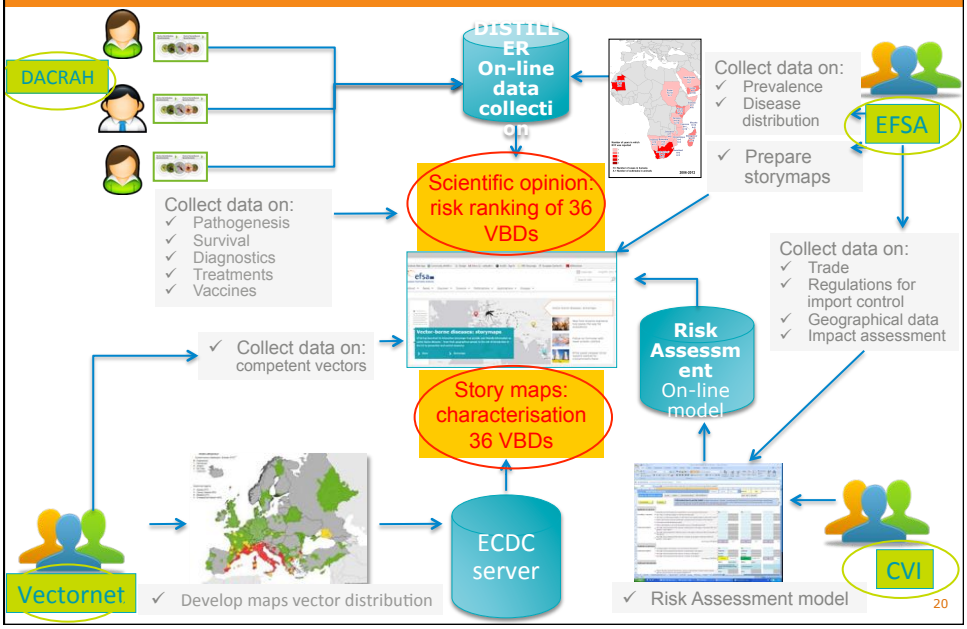
EXAMPLE: Mosquito borne diseases

18

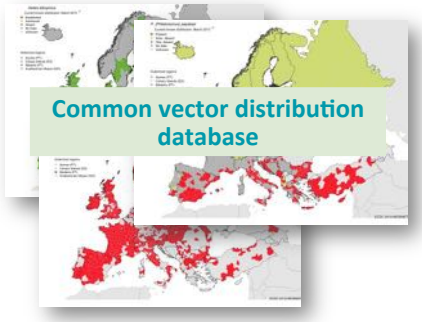
Characterisation of mosquito-borne diseases

	MBD's	Pathogens		Hosts									
		Species	OIE notifiable	Deer	Wild boar	Cattle	Sheep	Goats	Pigs	Horse	Dogs	Birds	Humans
1	CVV	Bunyamwera virus virus	No	X		x	X	x	x	X			
2	EEEV	Eastern equine encephalitis virus	Yes							X			x
3	GETV	Getah virus	No		X				x	X			
4	HJV	Highlands J. virus	No							X			
5	JEV	Japanese encephalitis virus	Yes		X				x	x			x
6	MIDV	Middelburg virus	No							x			
7	PHSV	Peruvian horse sickness virus	No							x			
8	RVFV	Rift Valley fever virus	Yes	X		x	X	x					x
9	SLEV	St. Louis encephalitis virus	No							x			
10	VEE	Venezuelan equine encephalitis virus	Yes							x			x
11	VSV	Vesicular stomatitis virus*	No	X		x	X	x	x	x			
12	WEEV	Western equine encephalitis virus	Yes							x			X
13	WSLV	Wesselsbron virus	No	X		x	X	x					
14	YUOV	Yunnan orbivirus	No				X	x		x			

COLLABORATION AND ORGANISATION OF ASSESSMENT

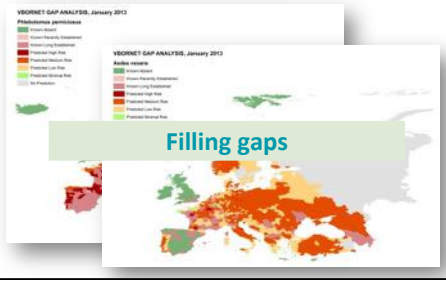


The project – expected outcome



Common vector distribution database

Support to risk assessments and opinions



Filling gaps

Improved human and animal health in Europe

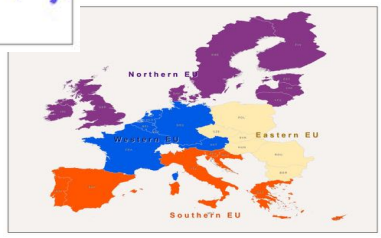
21

STORY MAPS OF VBD-MANDATE (2016 – 2017)

EXAMPLES OF THE STORY MAP ONLINE

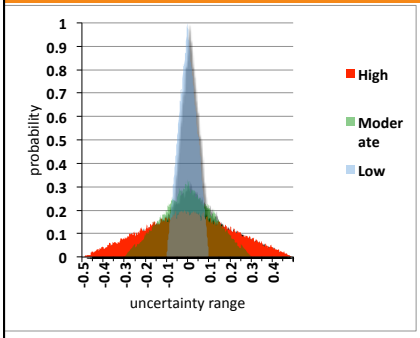
Japanese encephalitis (JEV)

Global occurrence



24

Global occurence



1. What is the geographic distribution of the VBD in the world?
2. How likely is it that the VBD is notified to the OIE?
3. What is the relative size of the infected area ?
4. What is the duration of undetected spread?
5. What is the frequency of the epidemics in the infected area?
6. What is the prevalence?

25

Global occurence

Mosquito borne virus	Abbreviation	Australia and New Zealand	Northern America	Central America	Caribbean	South America	Northern Africa	Eastern Africa	Middle Africa	Western Africa	Southern Africa	Western Asia	Eastern Asia	South-Eastern Asia	Southern Asia
Bunyamwera virus	CVV		X	X	X	X									
Eastern equine encephalitis virus	EEEV		X	X		X						X			
Getah virus	GETV												X	X	X
Highlands J. virus	HJV		X												
Japanese encephalitis virus	JEV												X	X	
Middelburg virus	MIDV							X	X	X	X				
Peruvian horse sickness virus	PHSV	X				X									
Rift Valley fever virus	RVFV						X	X	X	X	X	X			
St. Louis encephalitis virus	SLEV		X	X	X	X									
Venezuelan equine encephalitis virus	VEE			X		X									
Vesicular stomatitis virus	VSV		X			X									
Western equine encephalitis virus	WEEV		X	X	X	X									
Wesselsbron virus	WSLV							X	X	X	X			X	
Yunnan orbivirus	YUOV	X			X								X		X

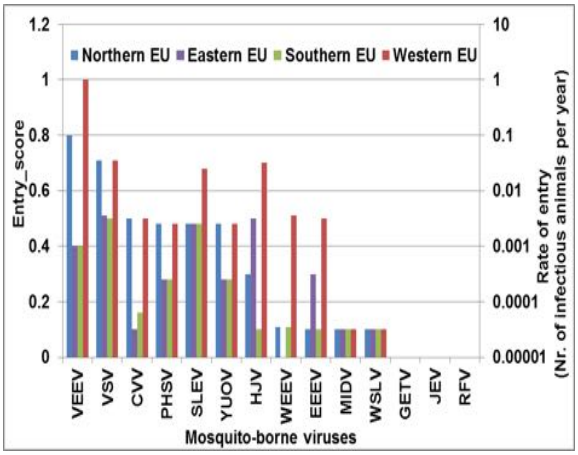
26

Annual rate of entry

7. What are the total numbers /volumes of animals/commodities moved along the pathway?

8. What is the probability of passing through the preventive/control measures before/at transport?

9. What is the probability that a viable VBD-agent is still present upon arrival in the area at risk?



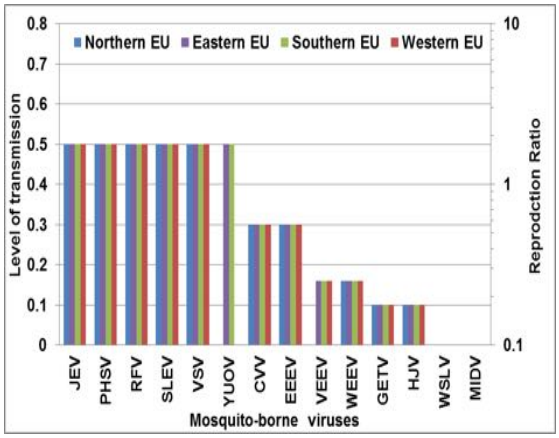
27

Level of transmission

10. What is the distribution of possible competent vectors in the area at risk?

11. What is the estimated value of the basic reproduction ratio?

12. Which fraction of the host population is susceptible?

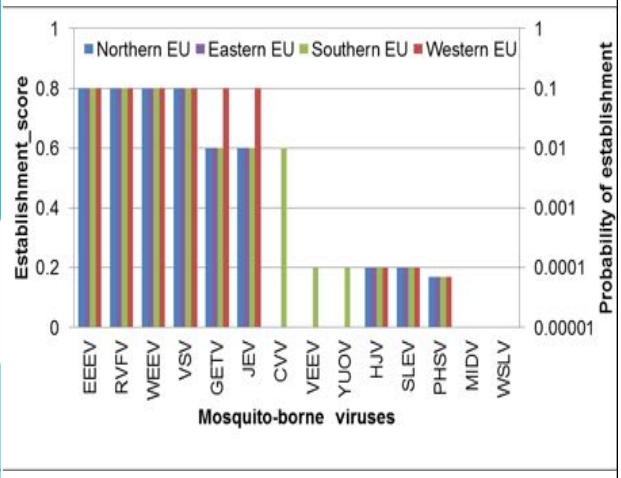


28

Probability of establishment

13. What is the probability of infecting a first local (indigenous) vector or host, given the pathway of entry and the expected region and time of entry ? (1st transmission step)

14. What is the probability of infecting a first local vector (given first infection of an indigenous host) or host (given first infection of an indigenous vector)? (2nd transmission step)



29

Annual rate of introduction

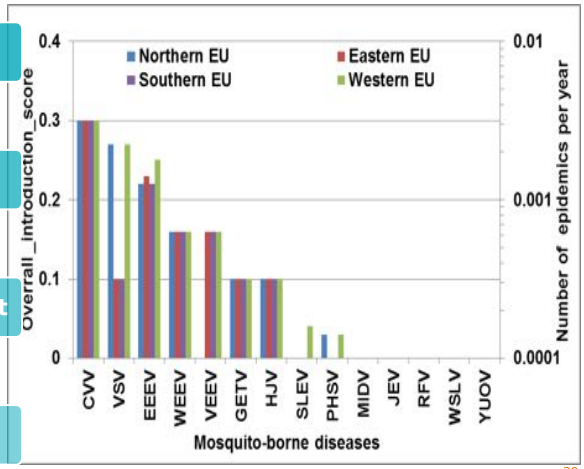
Global occurrence

Annual rate of entry

Level of transmission

Probability of establishment

Annual rate of introduction



30

Challenges?

Irreconcilable differences?

Risk managers: • No time • Urgent response	**Risk assessment:** • Need more time • Prevention
Complex methods • Epidemiological models • Systematic reviews • Expert elicitation processes	**Simple methods** • Rapid tools • Expert opinion
Big data • Animal movements • Populations	**No data** • Crucial epidemiological parameters (vector capacity?)

Preparedness!!

Keep assessments up to date: living reports/living opinions

Collaboration

COLLABORATION: CALL FOR VECTORNET 2 ON-LINE

A collaborative approach to data collection activities on vectors and pathogens they transmit

1.To collect existing published or unpublished information on the geographical distribution of priority vectors;
2.To further develop/maintain Network of medical, veterinary entomologists and public health professionals working in the field of vectors or vector-borne diseases;
3.To deliver ad-hoc scientific advice to support ECDC and EFSA;
4.To carry out targeted entomological surveillance.



https://etendering.ted.europa.eu/cft/cft-display.html?cftId=4079::

DEADLINE: 23/10/2018 16:00

Vector control : With what- where -how?

- Approved products?
- Approved applications?
- Resistance
- Priorities?

Collaborative one-health approach in EU

34

ACKNOWLEDGEMENTS

- **AHAW Panel:** More S. (chair), Bicout D., Bøtner A., Butterworth A., Calistri P., Depner K., Edwards S., Garin-Bastuji B., Good M., Schmidt C.G. , Michel V., Miranda M.A., Saxmose N.S., Raj M., Sihvonen L., Spoolder H., Stegeman A., Thulke H.H., Velarde A., Willeberg P., Winckler C.
- **VBD working group:** Stegeman A. (chair), Bicout D., Aline de Koeijer, Miranda M.A., Thulke H.H.
- **EFSA staff:** Dhollander S. (coordinator), Bau A., Beck B.B., Carnesecchi E., Georgiadis M., Casier P. Czwienczek E., Gogin A., Lima E., Matteucci F., Pasinato L. , Richardson J., Riolo F., Rossi G. and Watts M.

35

Subscribe to
www.efsa.europa.eu/en/news/newsletters
www.efsa.europa.eu/en/rss

Engage with careers
www.efsa.europa.eu/en/engage/careers

Follow us on Twitter
@efsa_eu
@plants_efsa
@methods_efsa

36