

# Spotless strawberry plants: how to keep them free from *Xanthomonas*?

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# *Xanthomonas fragariae* (Xf)



- Causative agent of angular leaf spot
- Disease is mainly found in field crops
- Q-organism (EPPO A2) in propagation material
- Under high-moisture conditions, bacteria exude from leaf spots and provide secondary inoculum
- Inoculum is disseminated in various ways
- Cells deposited on plants may enter via wounds or natural openings (stomata or hydathodes)
- Disease development is favoured by moderate temperatures (18 - 24 °C) and a high air humidity (rain, mist, irrigation)

# Aim of our study

- Assess risks on dissemination of Xf in a symptomatic strawberry crop by:
  - machineries
  - splash water
  - Aerosols
- Assess inoculum thresholds for infection of plants
- To transfer information in practical advices to growers



# Spread by mowing machines

- Experimental design

						Plant 1-1	Plant 1-2	Plant 1-3		Plant 1-5						Plant 1-10	Xf-vrij
	Krat 2-1	Krat 2-2	Krat 2-3	Krat 2-4	Krat 2-5	Plant 2-1	Plant 2-2	Plant 2-3		Plant 2-5						Plant 2-10	Xf
						Plant 3-1	Plant 3-2	Plant 3-3		Plant 3-5						Plant 3-10	Xf-vrij
	Krat 4-1	Krat 4-2	Krat 4-3	Krat 4-4	Krat 4-5	Plant 4-1	Plant 4-2	Plant 4-3		Plant 4-5						Plant 4-10	Xf
						Plant 5-1	Plant 5-2	Plant 5-3		Plant 5-5						Plant 5-10	Xf-vrij
	Krat 6-1	Krat 6-2	Krat 6-3	Krat 6-4	Krat 6-5	Plant 6-1	Plant 6-2	Plant 6-3		Plant 6-5						Plant 6-10	Xf



# Spread by mowing

Before



After



# Mower can become heavily contaminated

Treatment	Sampling time	% Infected (N=3)	Avg densities (cfu/g)
Non-infected plants	After mowing source	0	0
	After mowing entire bed	0	0
Infected plants	After mowing source	100	$6 \cdot 10^7$
	After mowing entire bed	100	$6 \cdot 10^7$

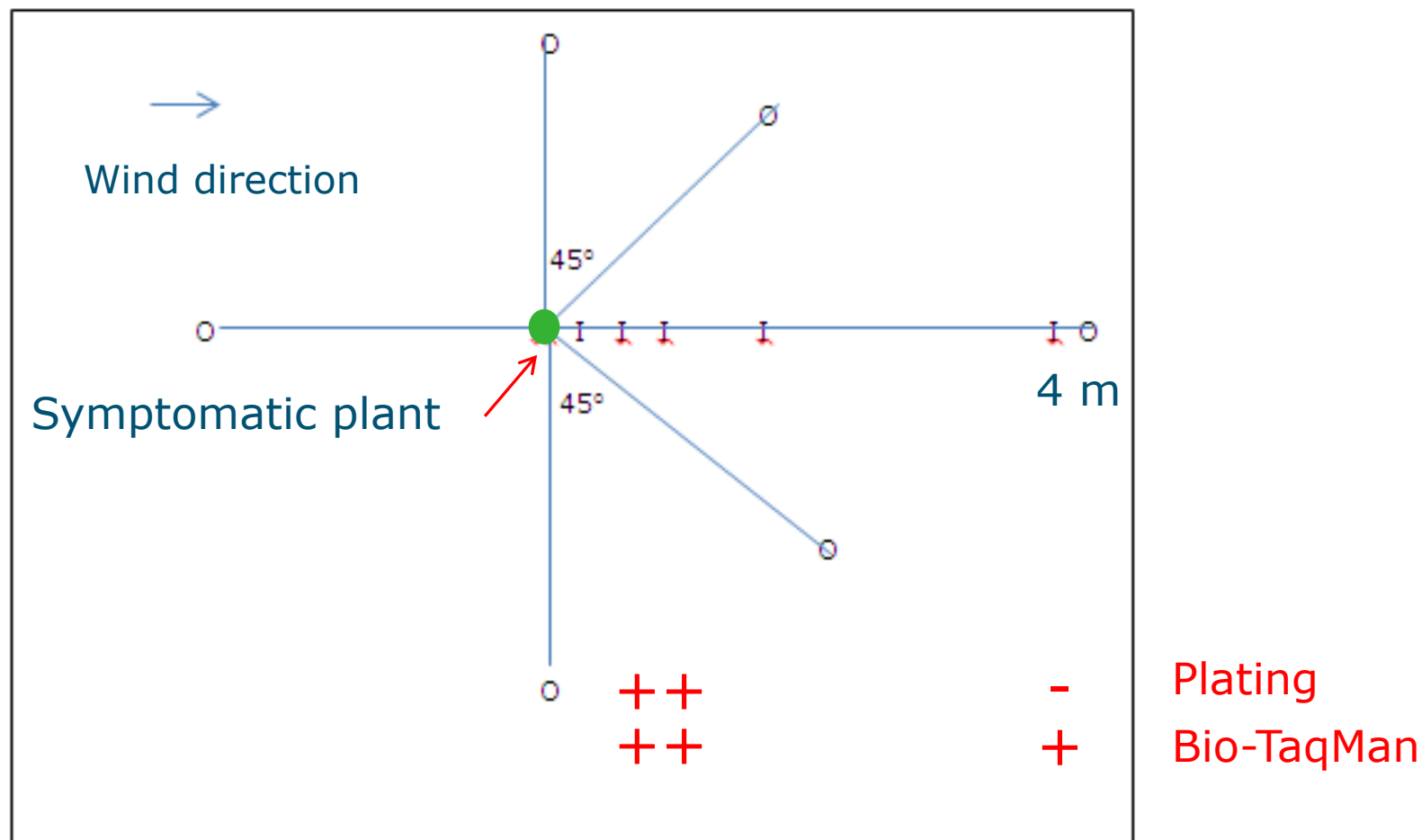
Washing of machines with water is not sufficient!

# Mower can contaminate plants

Source plant	Plant nr. in row	% positive (N=3)	Densities (cfu/g)
Infected plants	1	100	$3 \cdot 10^5$
	2	100	$3 \cdot 10^5$
	3	100	$2 \cdot 10^5$
	5	100	$1 \cdot 10^5$
	10	100	$2 \cdot 10^3$
non-infected	1	100	low
	2	100	low
	3	100	low
	5	100	low
	10	100	low

Population increased in plants after mowing (in 14 days → 100X)

# Limited spread by splash water



Irrigation time: 4 h

Water was collected at various distances from plant  
Before analysis, bacteria were concentrated



# Risks of spread by aerosols

## Experimental set up:

### ■ ***Spread via a sprayer***

- In 30-90 s, release of 2 L inoculum ( $10^8$  cfu/ml)

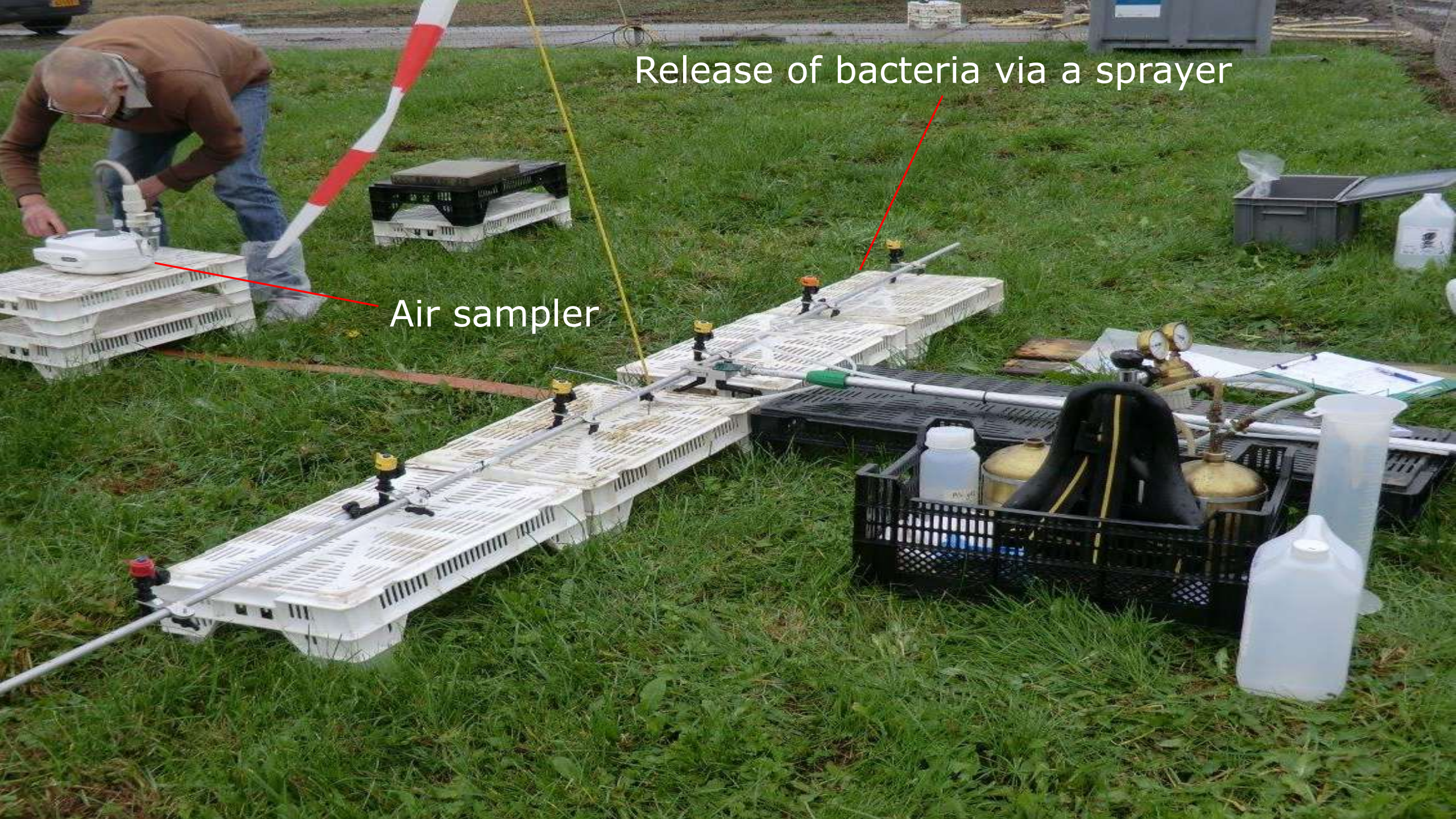
### ■ ***Spread during mowing of a (wet) crop***

- Tray-plants were used placed in a row  $90^\circ$  upon the direction of the wind
- First non-infected material was mown, thereafter infected material in three runs
- Material was collected with
  - air sampler
  - Particle counter
  - Tray to collect leaf material



Release of bacteria via a sprayer

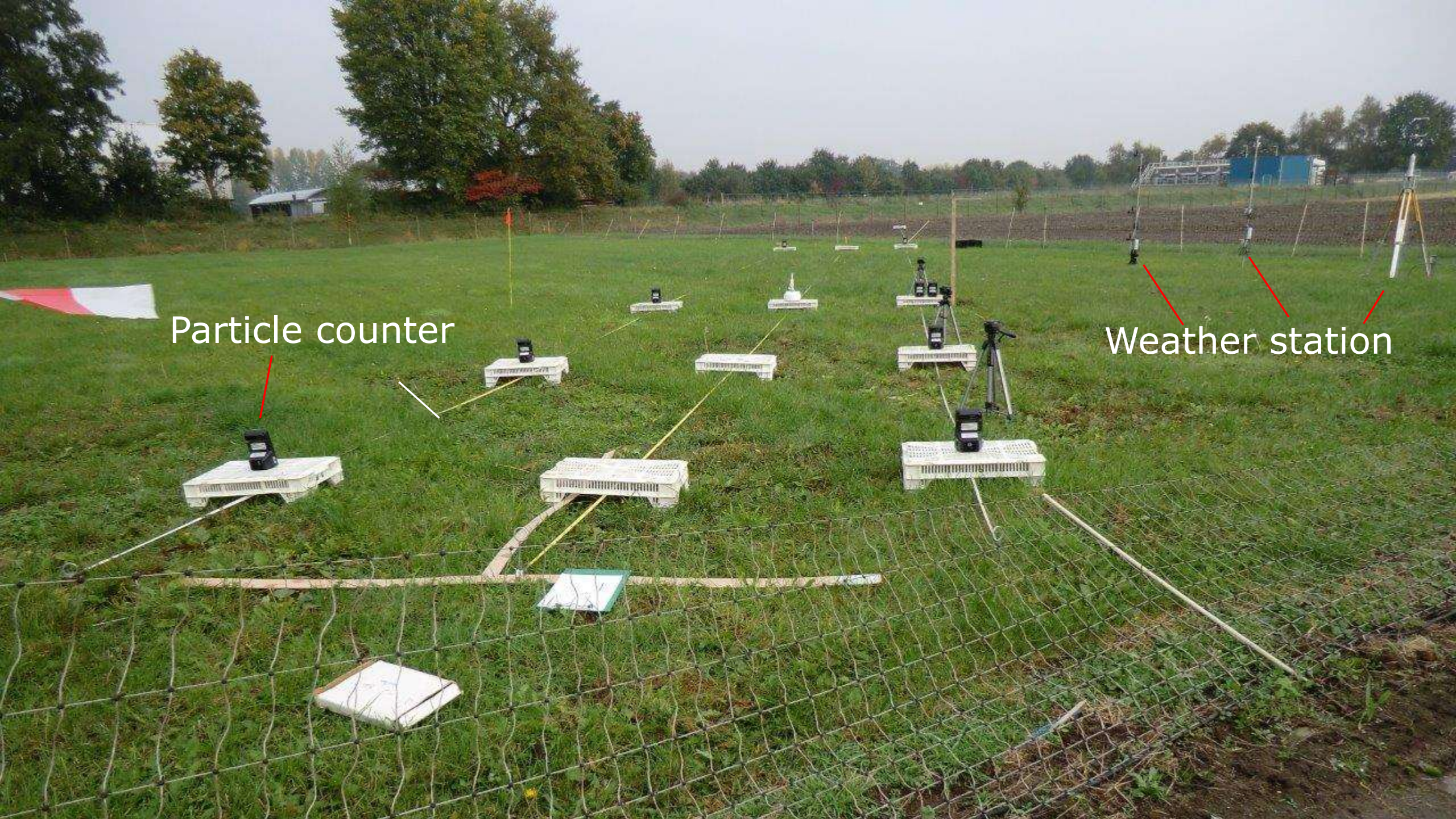
Air sampler





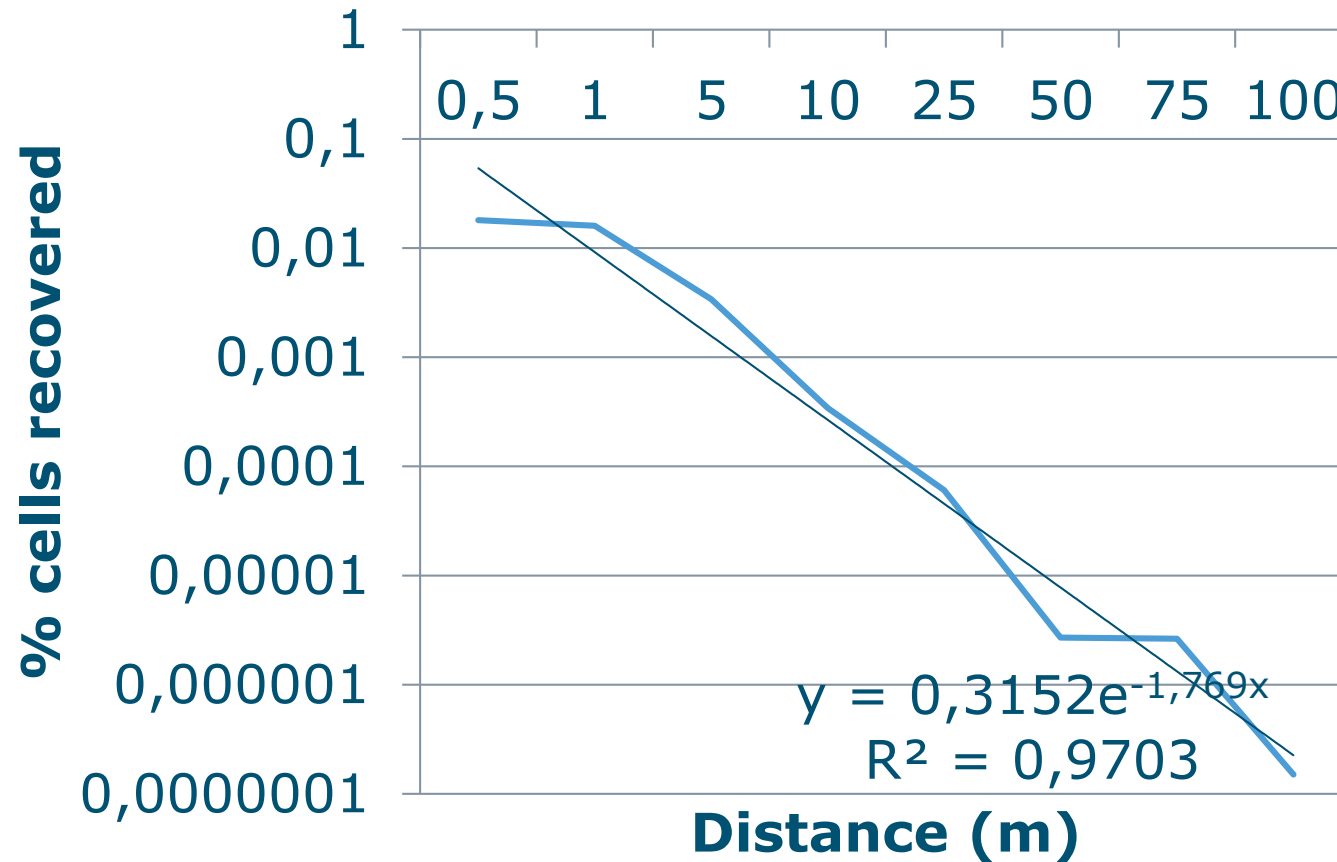
Particle counter

Weather station



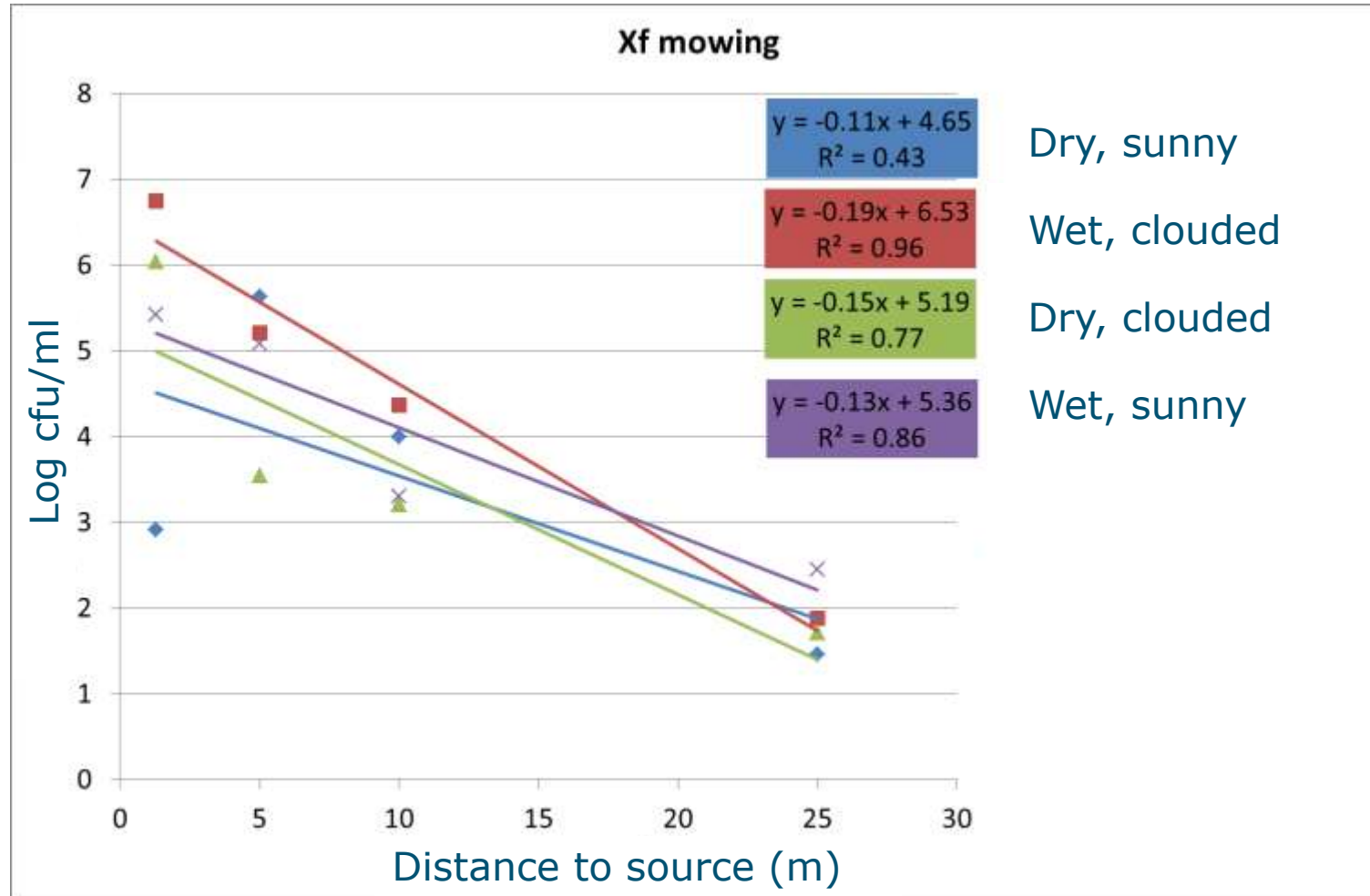


Contaminated aerosols released with a sprayer can be trapped  $\leq 100$  m source



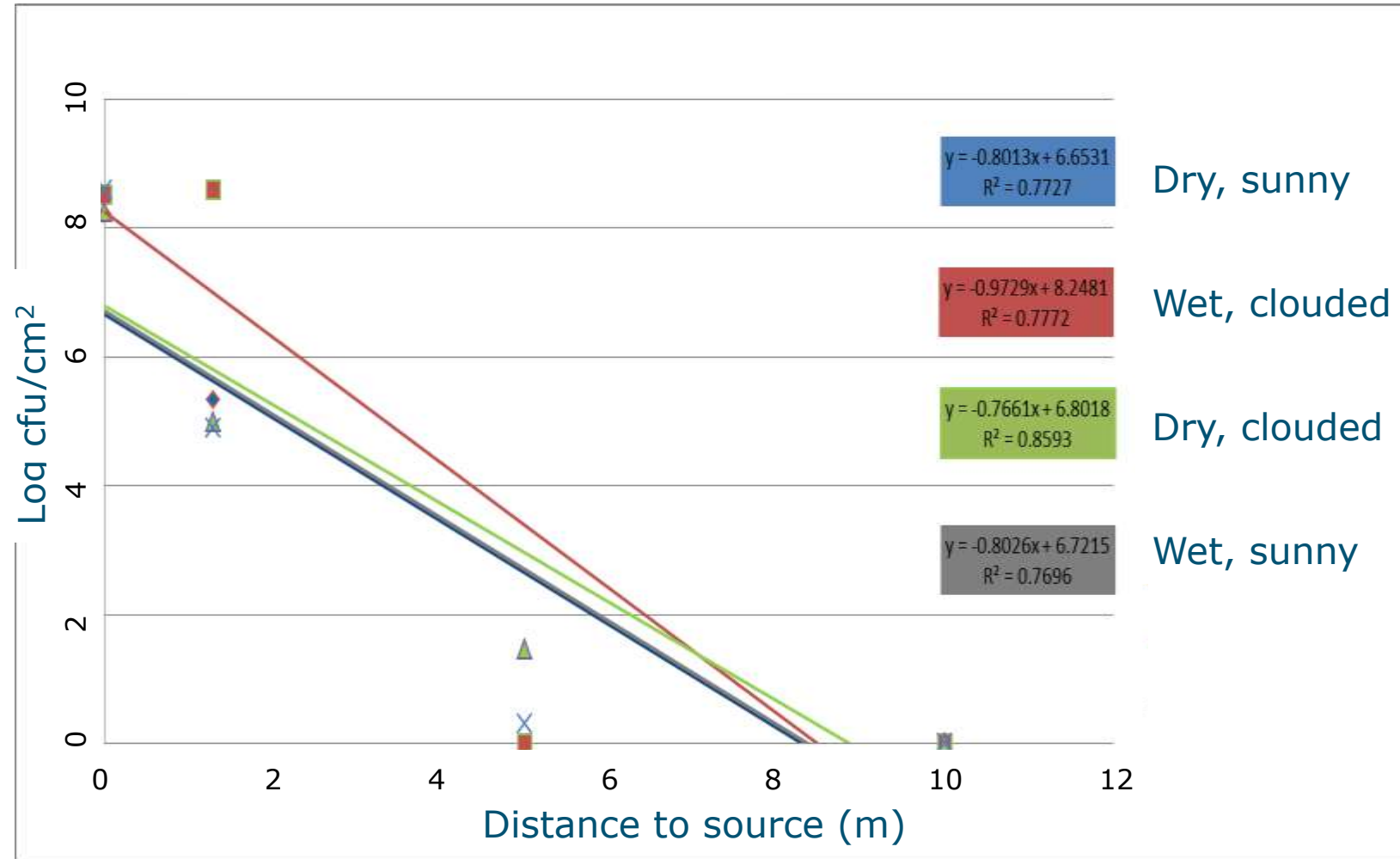
Release of ca.  $10^{11}$  cells

And released by a mower  $\geq 25 - 50$  m  
(independent on the weather conditions)

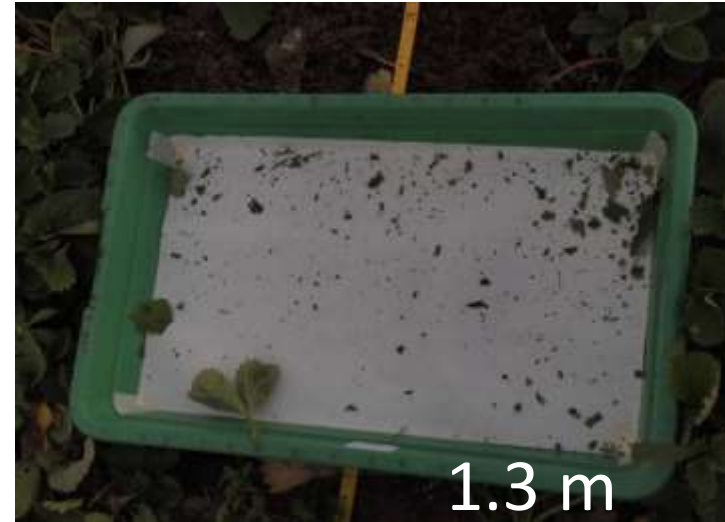




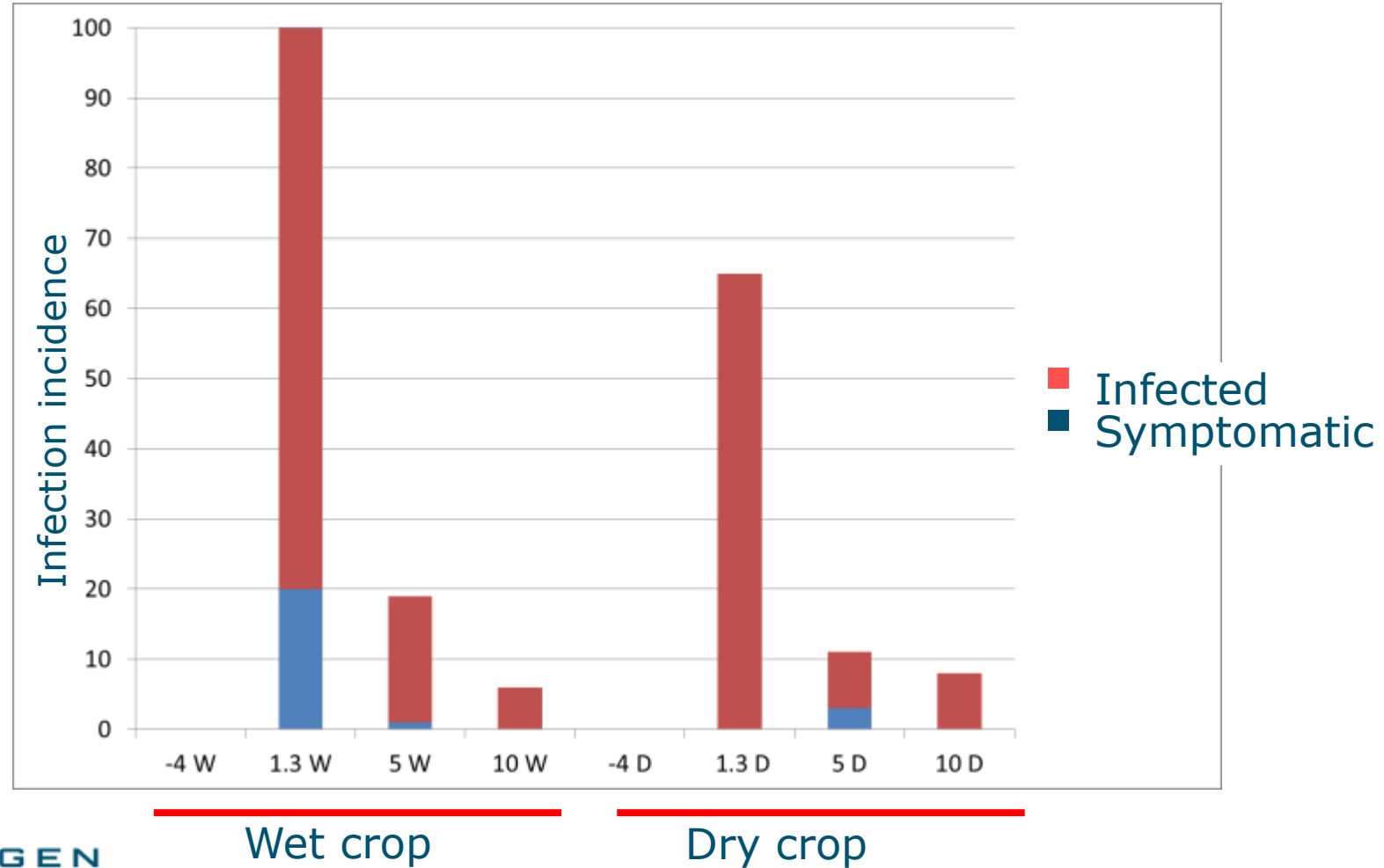
# Limited spread by leaf particles!?



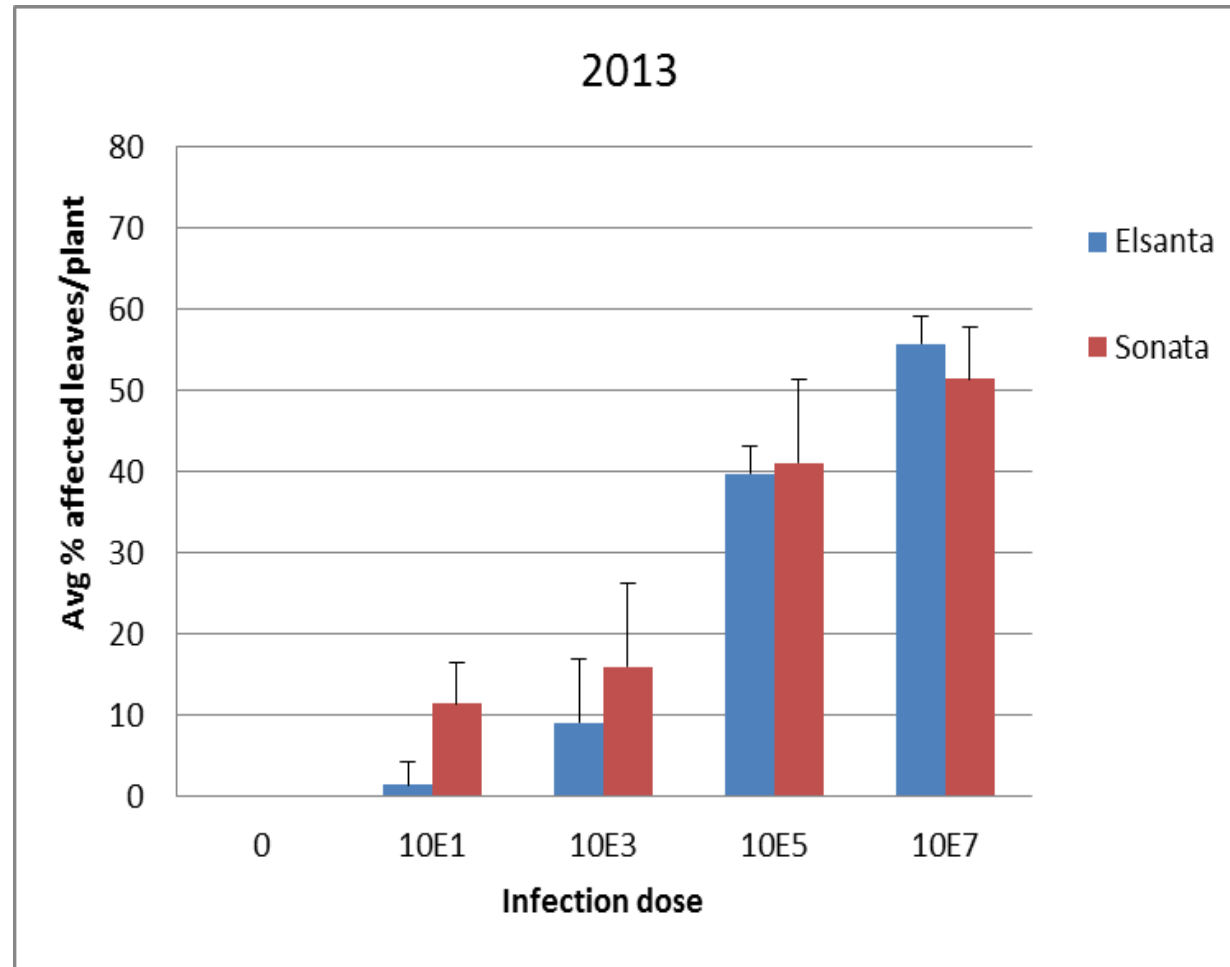
# Spreading via leaf particles



# Spread by aerosols can result in (symptomatic) infections



# Low densities of Xf can result in symptomatic plants



Glasshouse experiments, conditions: 17 ° C, 70 % RH

# Take home messages

- Preferably, do not grow strawberry propagation crops in close proximity
- In particular, keep a distance between a high- and a low grade crop
- Mow at sunny and dry conditions to avoid secondary infections
- Use protective shields around mower blades to reduce spread of Xf during mowing
- Wash and disinfect machines before entering a new crop



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