

A dynamic model for downy mildew primary infection on grape

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Many forecasting models for *P. viticola* primary infection, were developed

None of them proved to be precise and robust

Current warning systems are mainly based on
"Three 10 Rule"

In spite of the fact it is often unreliable

A new approach:

- Pathosystem analysis
- data and information collection
- mathematic relationships build-up
- dynamic simulation

Validation

Emilia-Romagna 1995 - 2002, several localities

Piemonte 1999 -2002, several localities

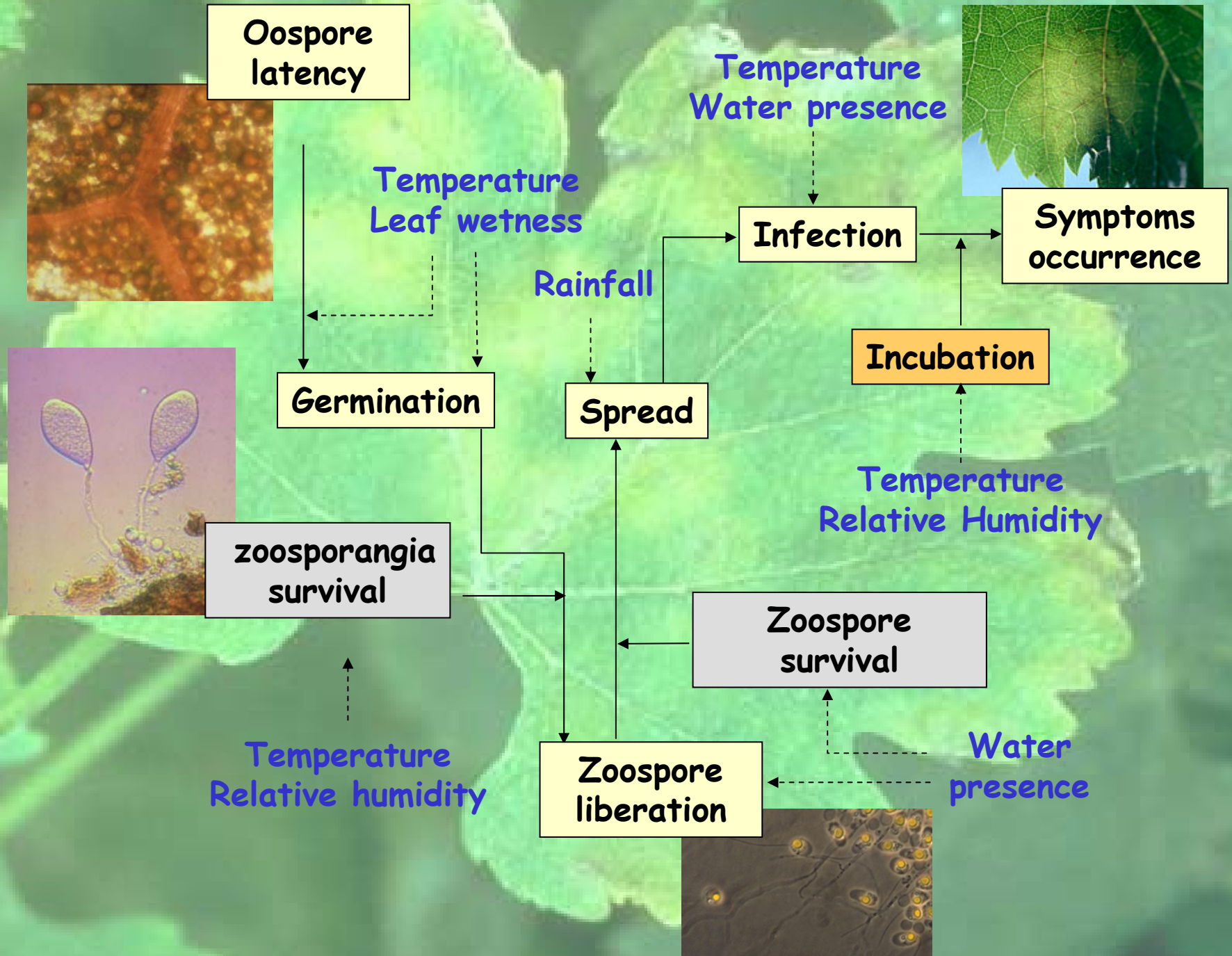
Oltrepò Pavese 1998 - 2002

In 2003

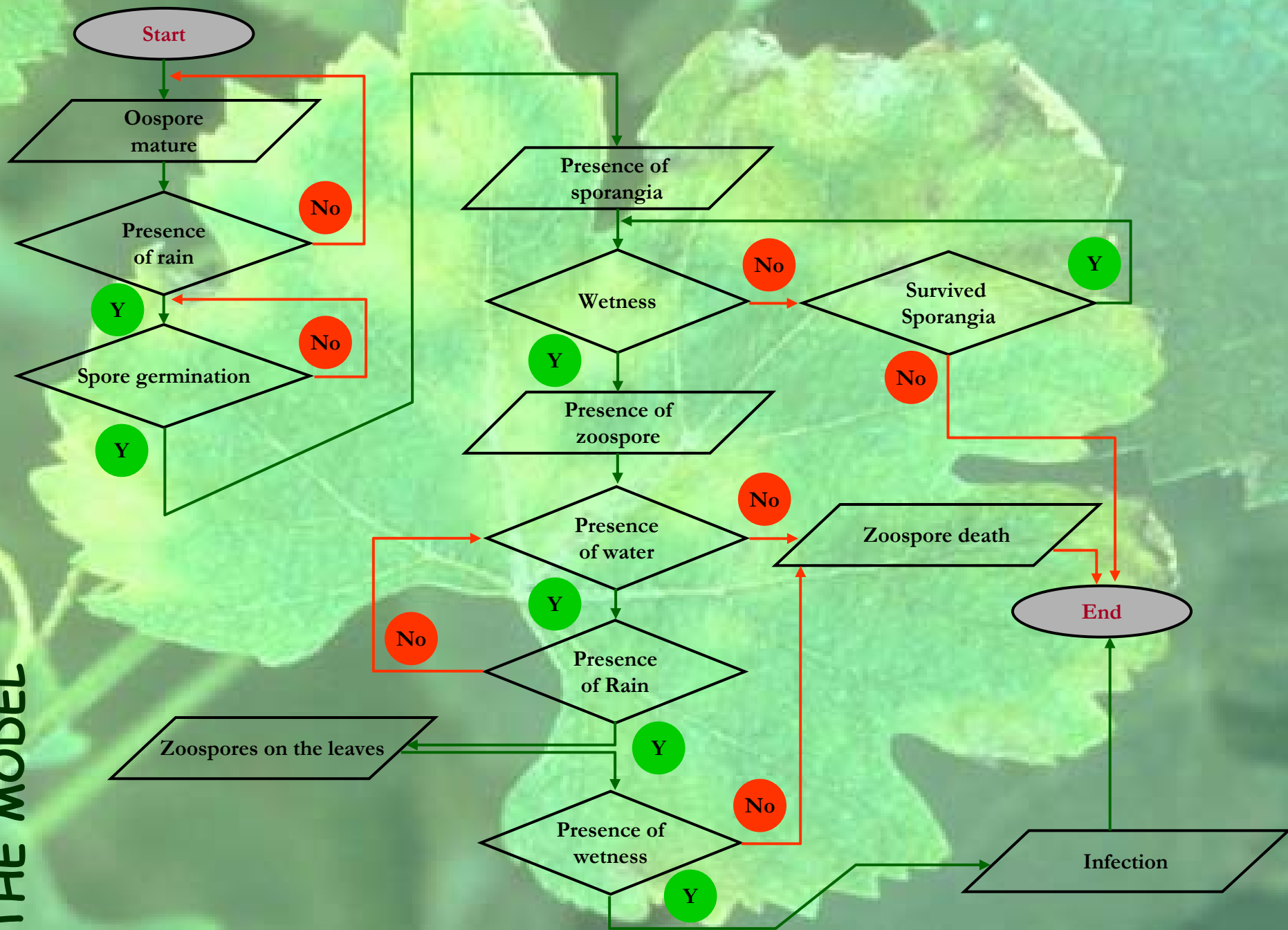
Emilia-Romagna

Piemonte

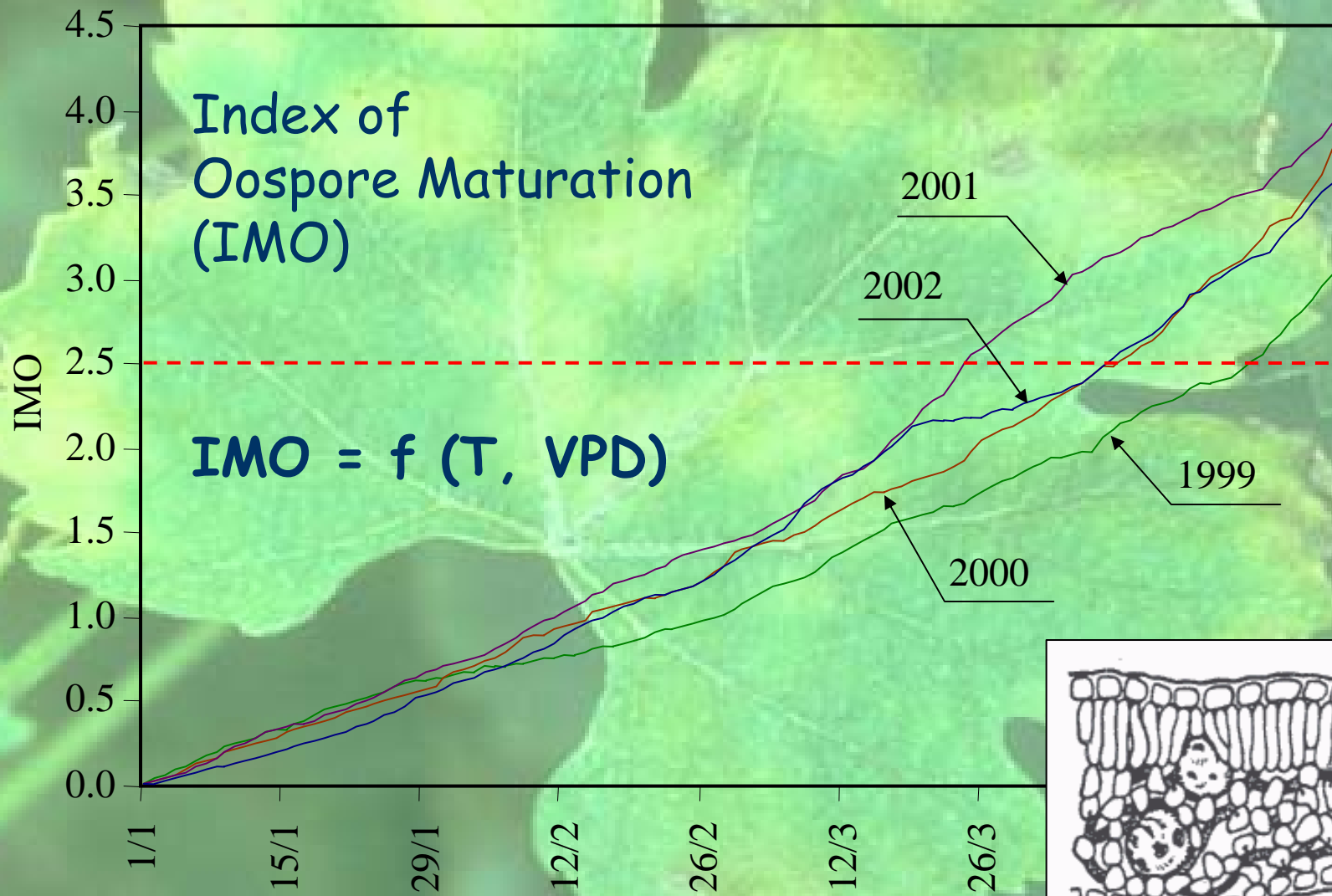
THE MODEL



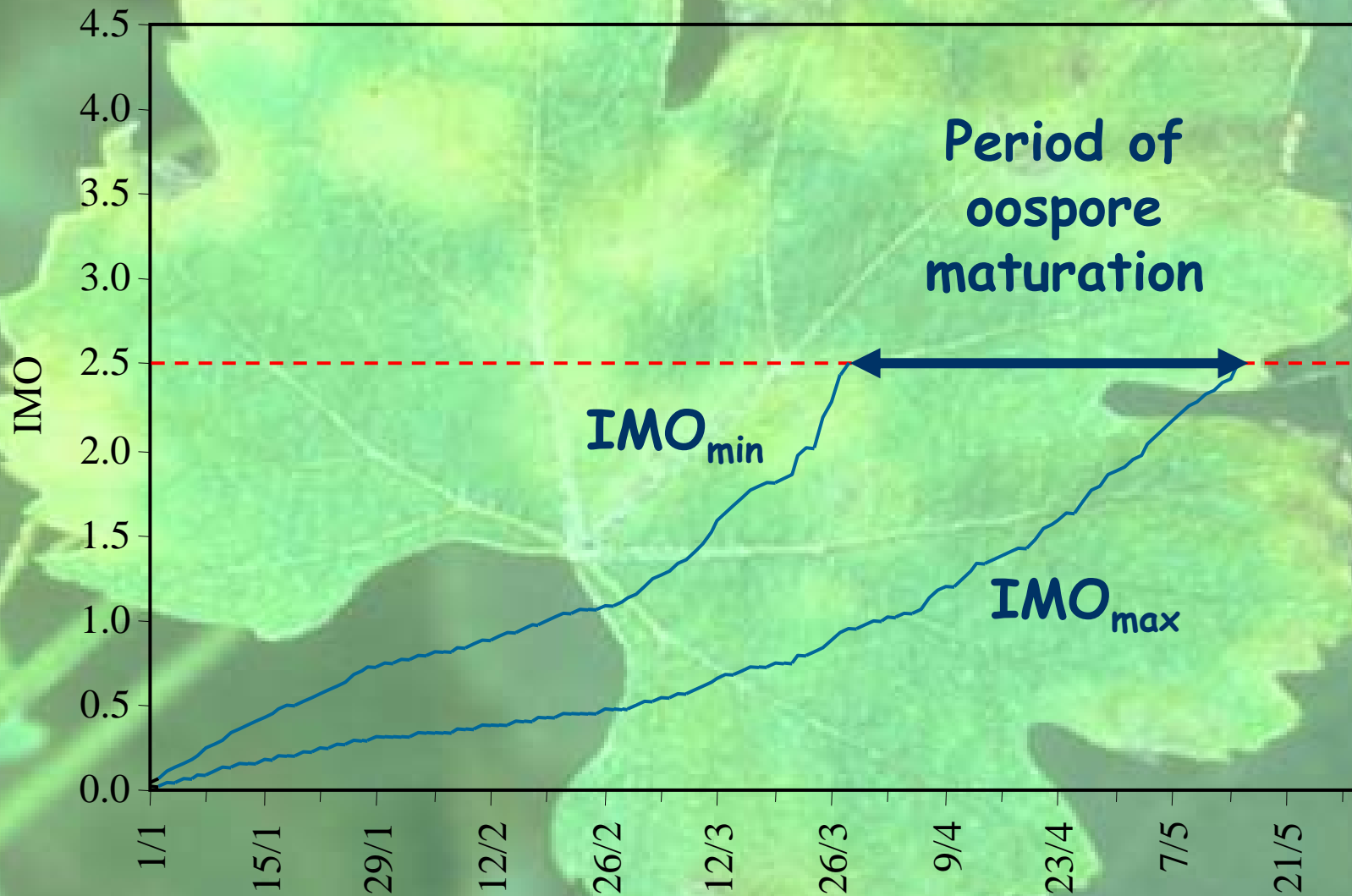
THE MODEL



1. Oospore latency



1. Oospore latency



THE MODEL

2. Oospore germination

Frequency of
mature oospores

Start of
germination

$f(R)$

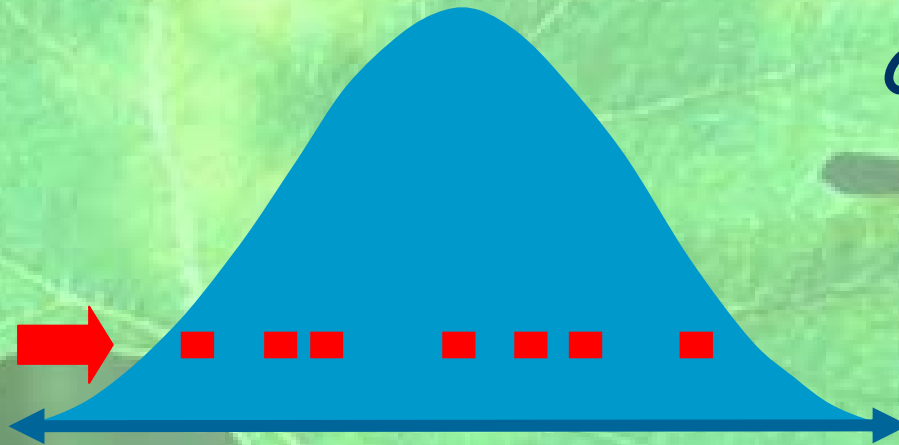
Coorts of
mature
oospores

IMO_{min}

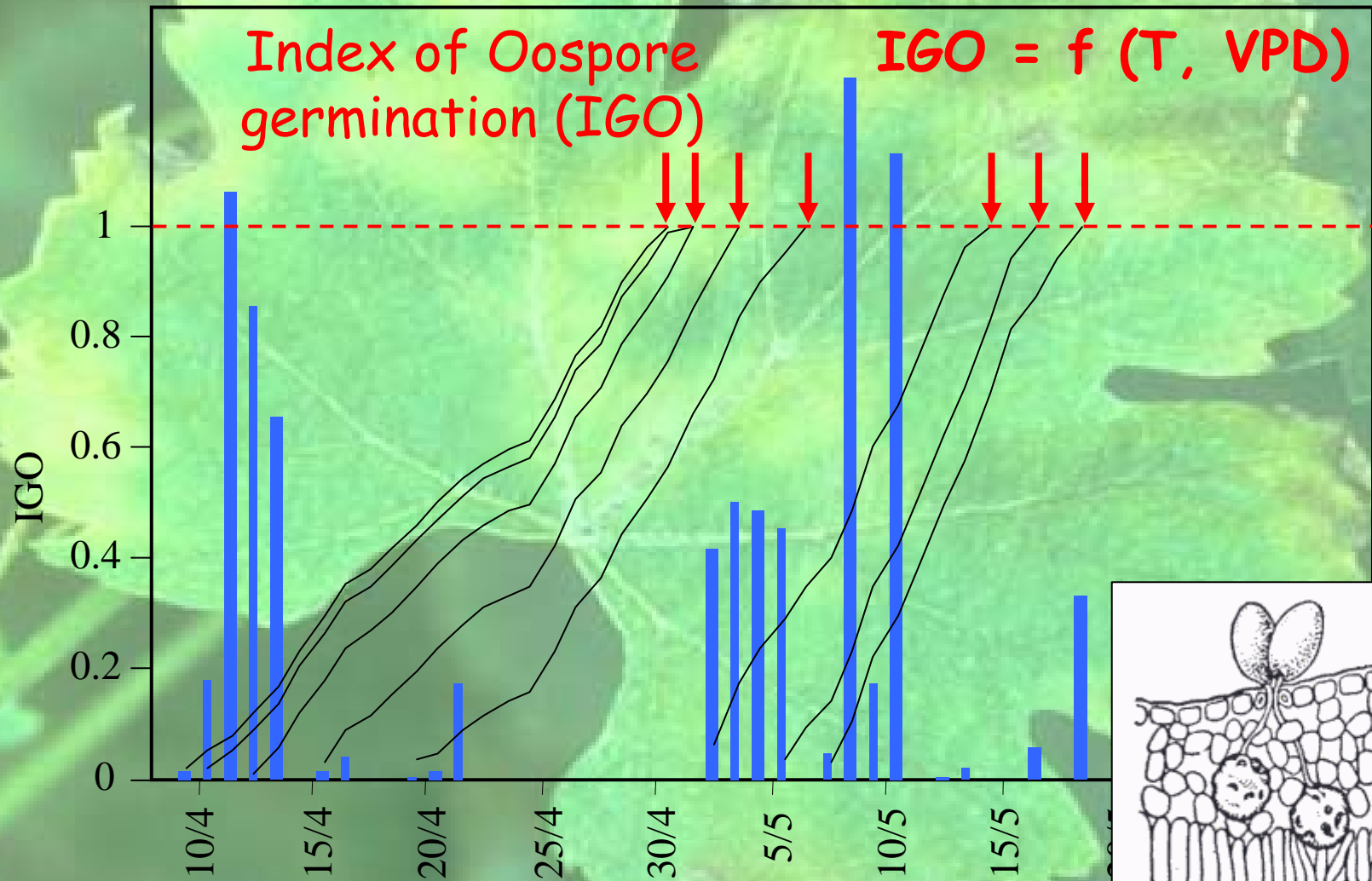
IMO_{max}

Period of
oospore
maturation

THE MODEL

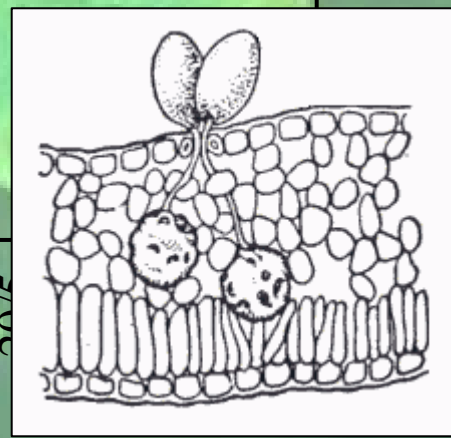
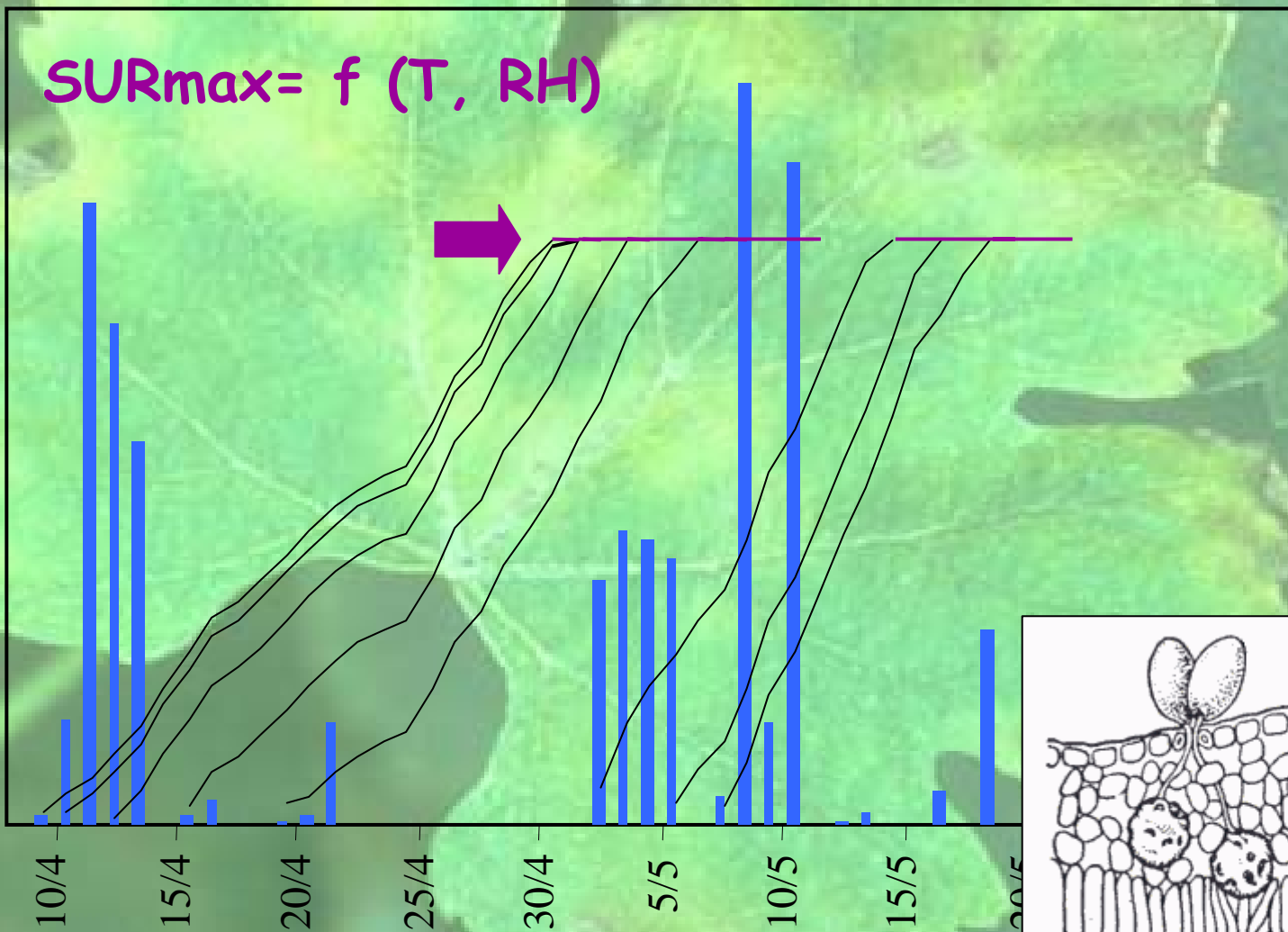


2. Oospore germination



3. Sporangia survival

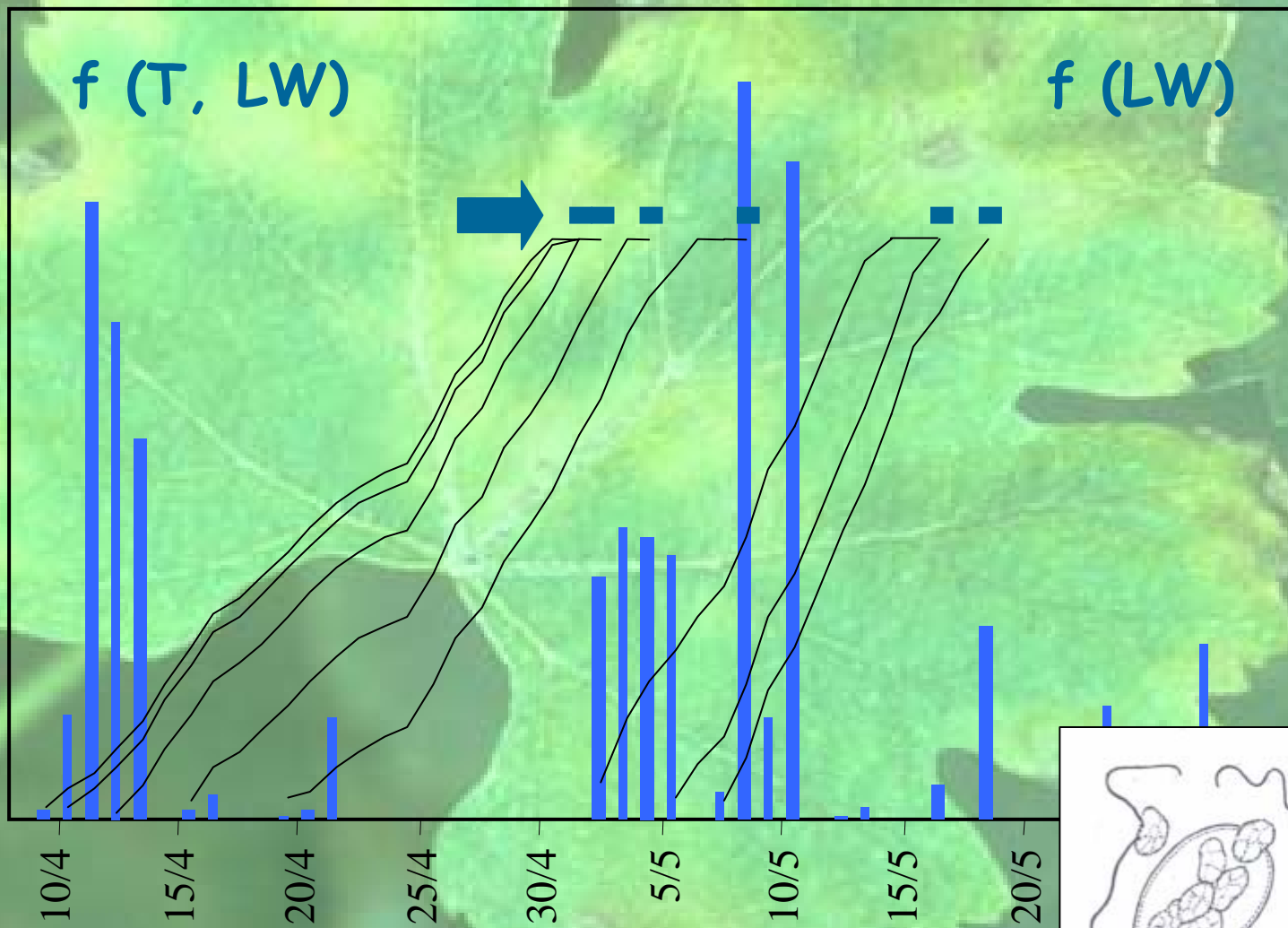
$$SUR_{max} = f(T, RH)$$



THE MODEL

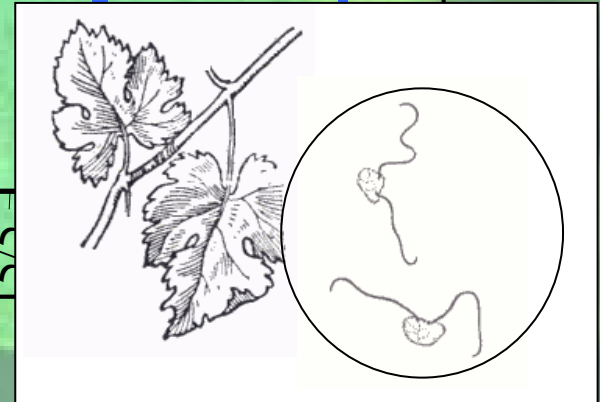
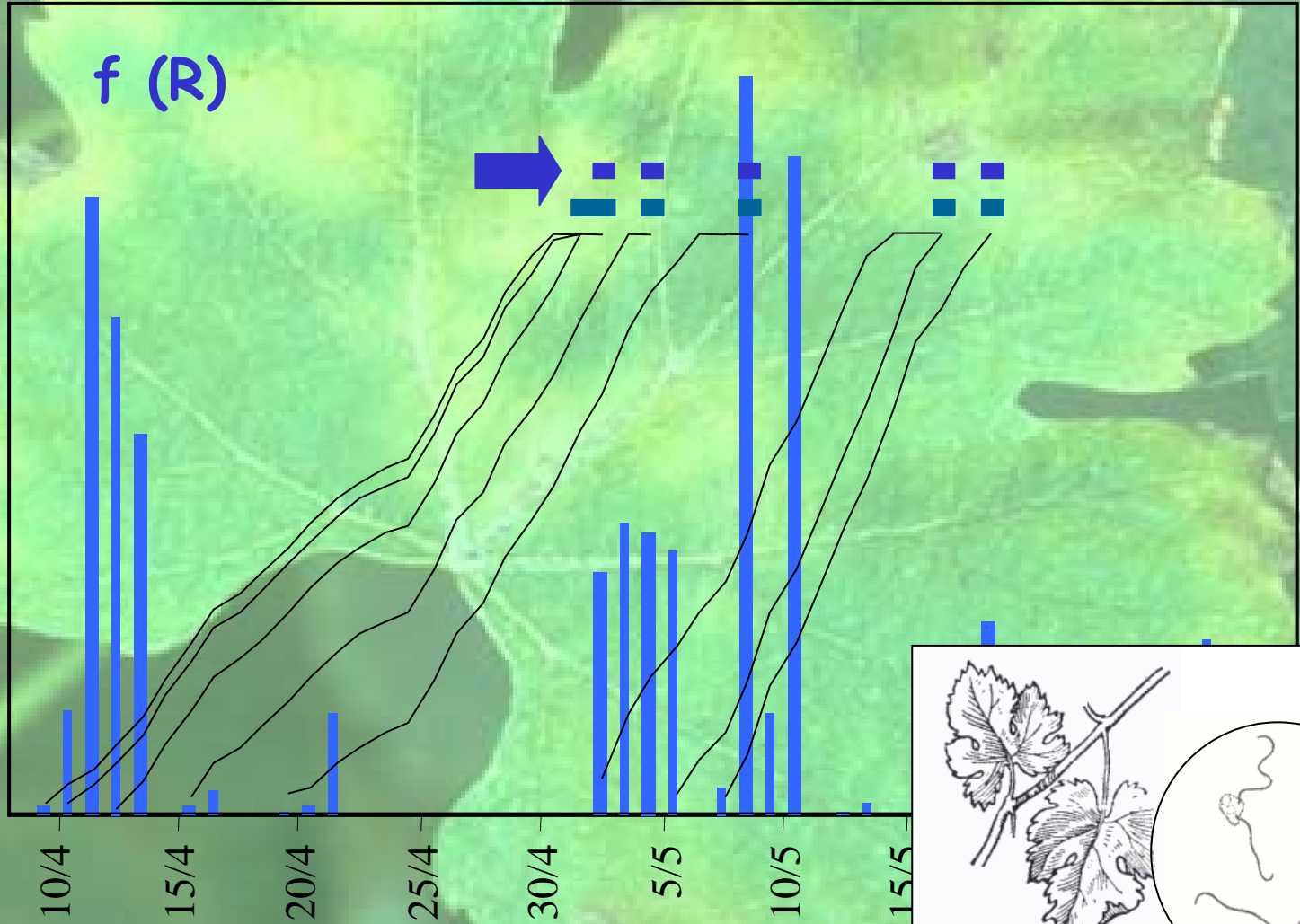
4. Sporangia germination

5. Zoospore survival



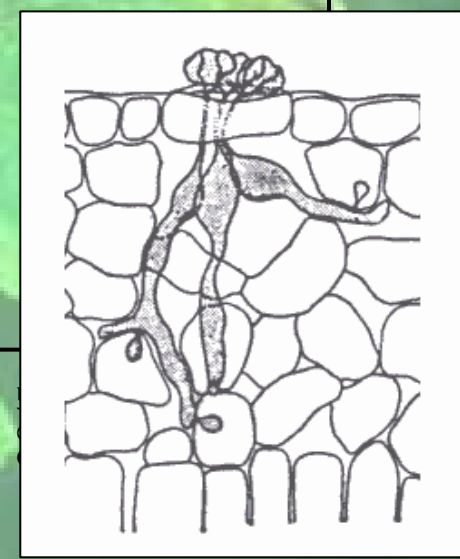
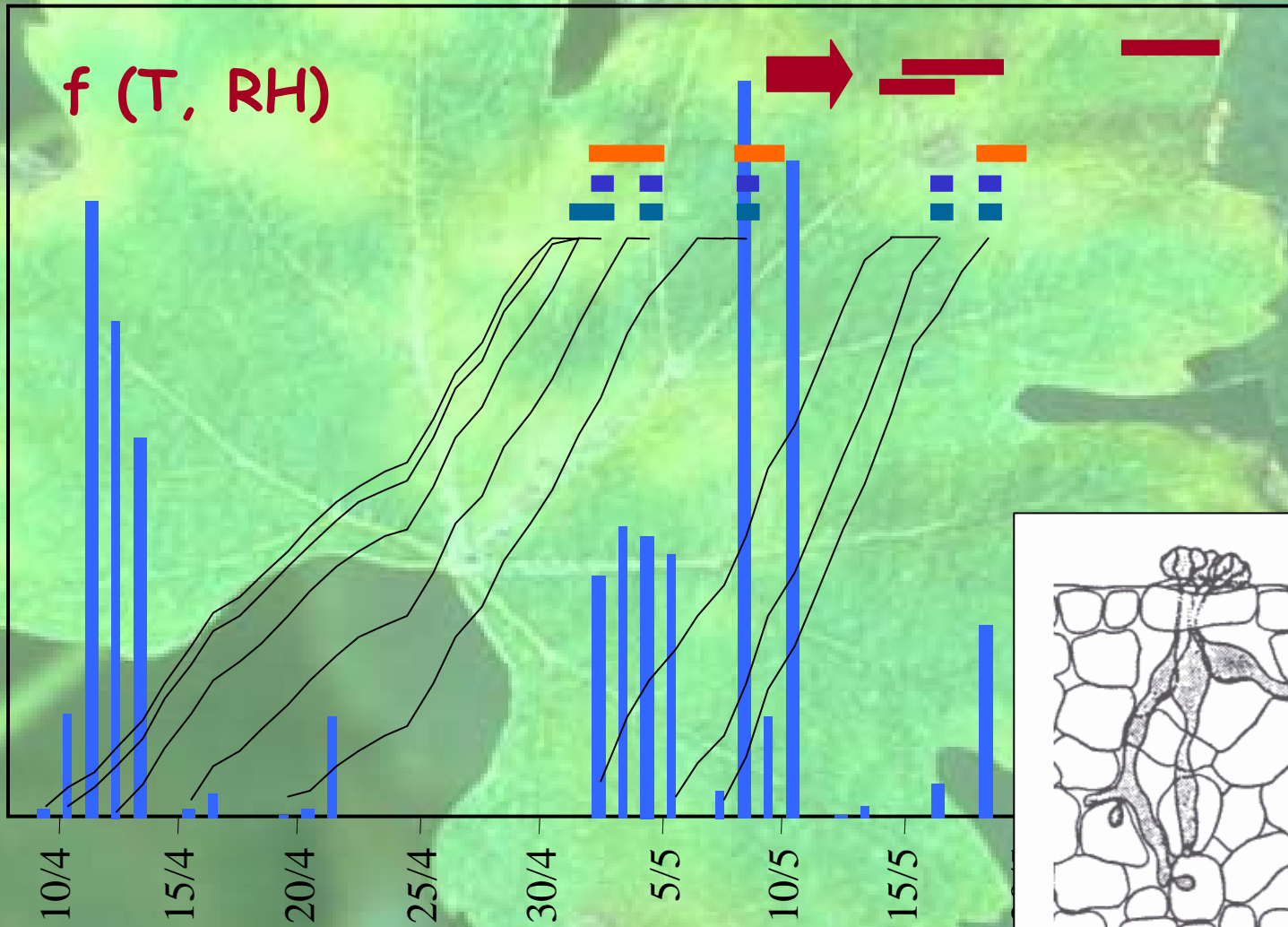
THE MODEL

6. Zoospores dispersion

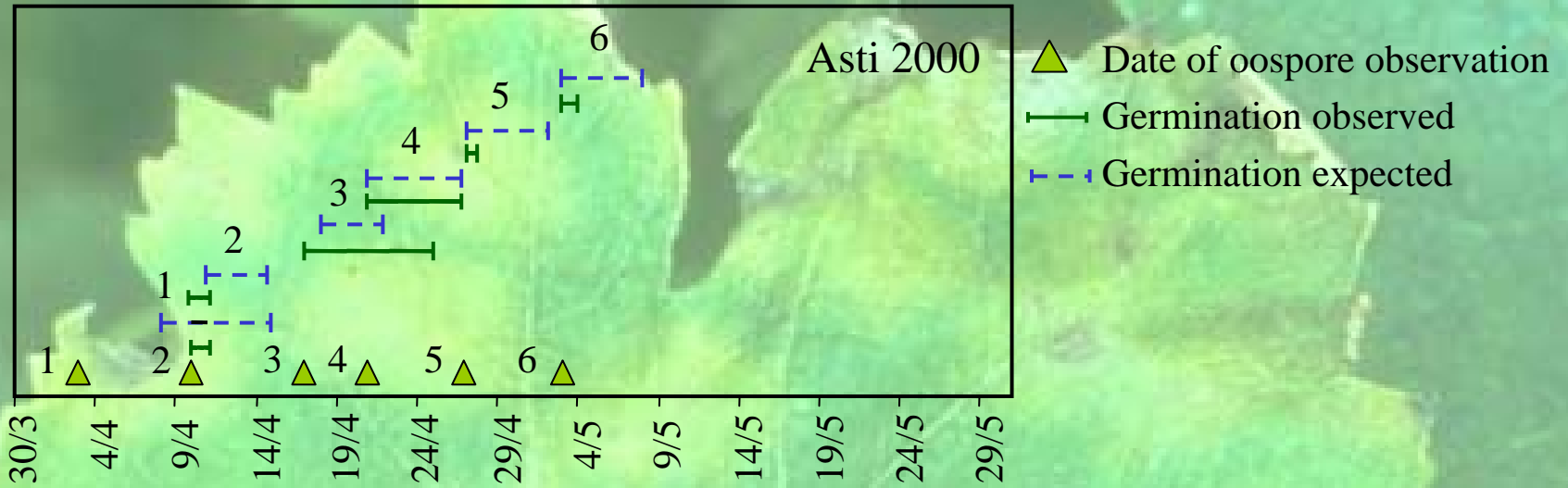


THE MODEL

8. Incubation and symptom occurrence



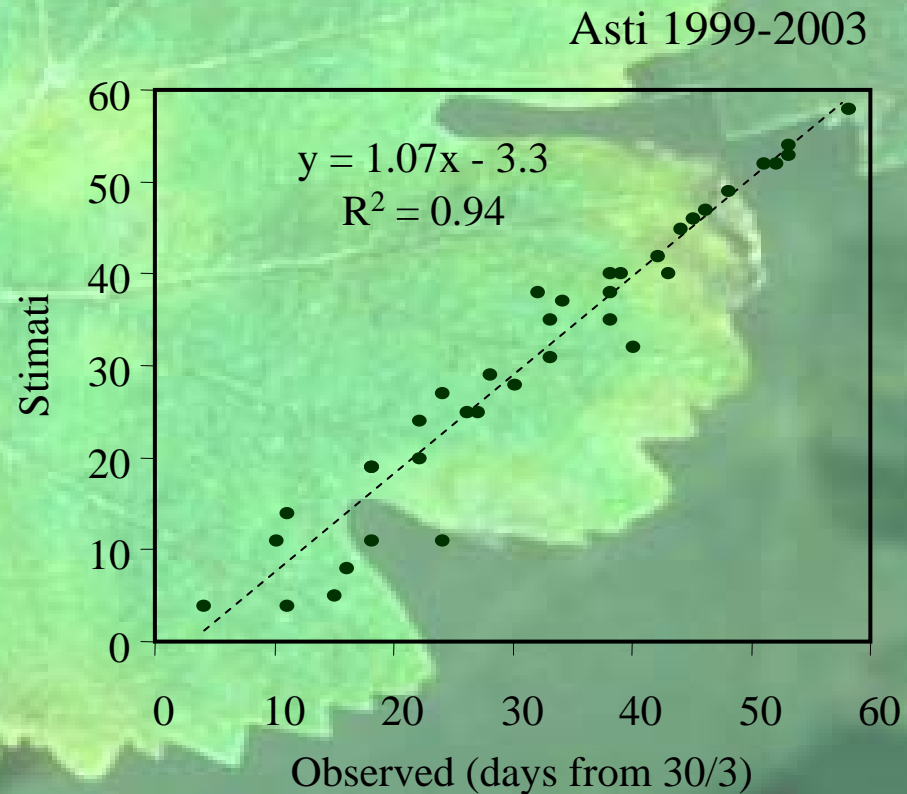
THE MODEL



Velocity of oospore germination

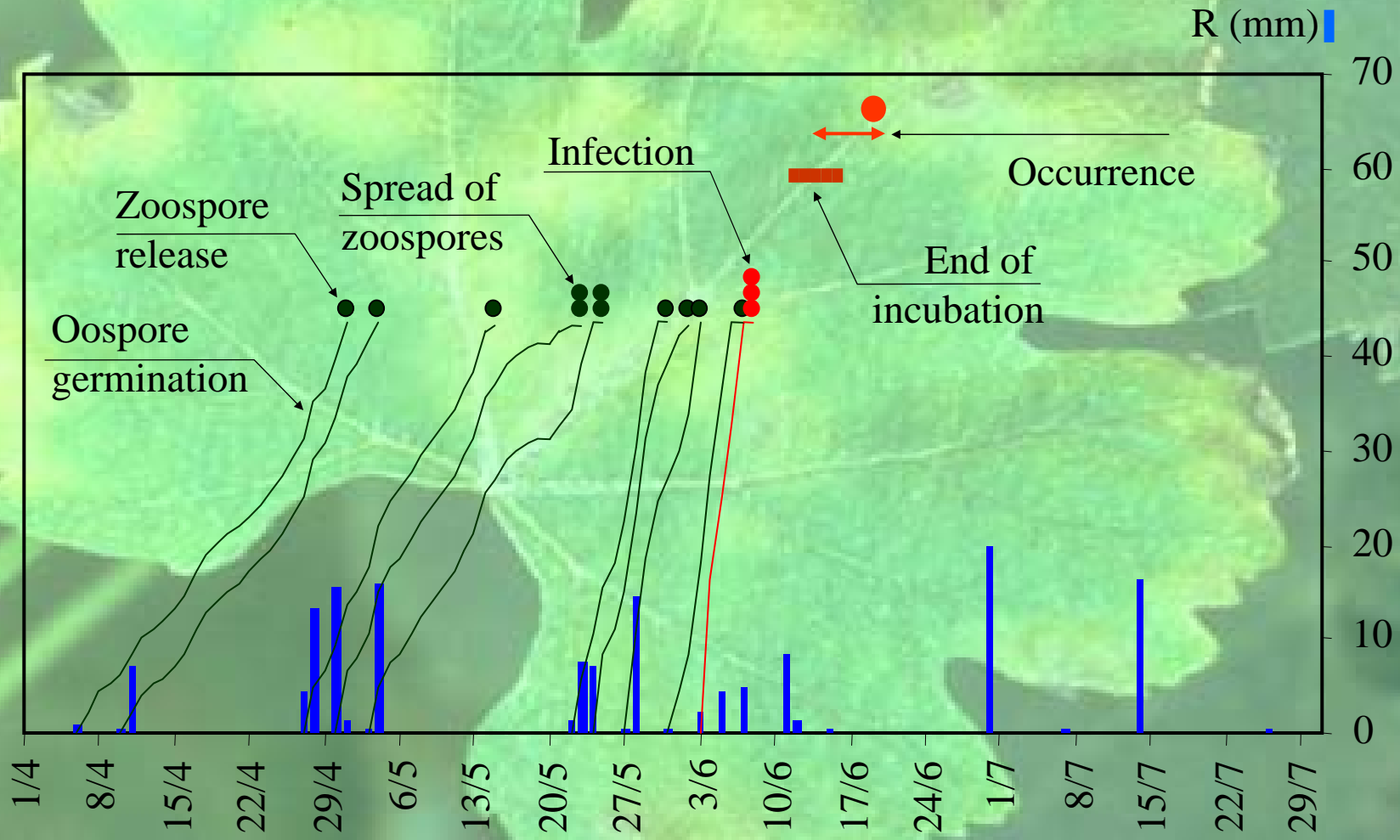
Estimated values of the model
vs
Observed values for oospores
overwintered in vineyard
(floating disk method)

Asti 1999-2003

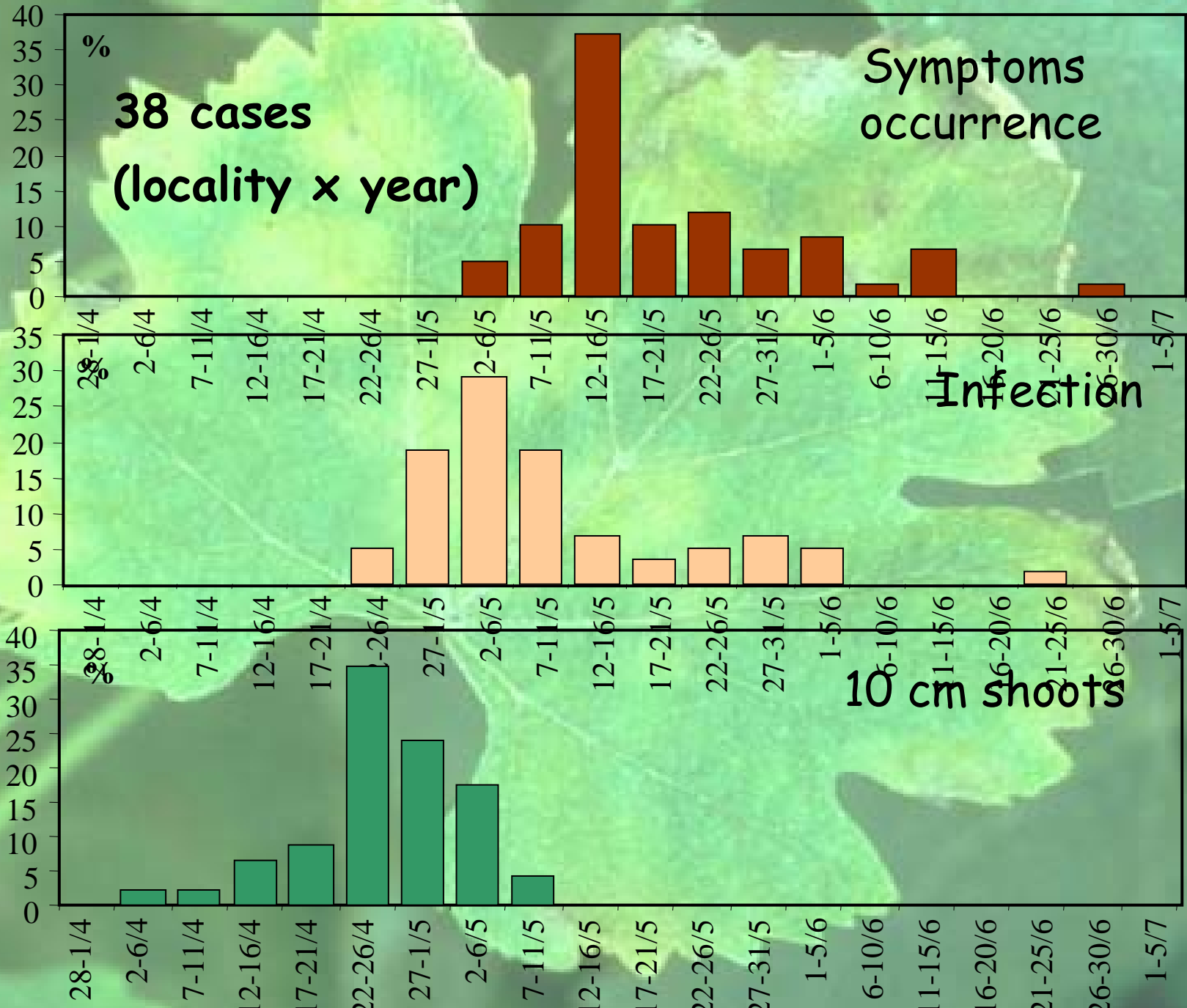


Date primary symptoms occurrence

Model's estimated date vs Observed date in vineyard



THE VALIDATIONS - Symptom occurrence



THE VALIDIZIONS - Symptoms occurrence

308 simulations

291 correct

17 uncorrect

Infection observed

		Infection observed	
		no	yes
Infection expected	no	232 75.3%	0 0%
	yes	17 5.5%	59 19.2%

False alarms

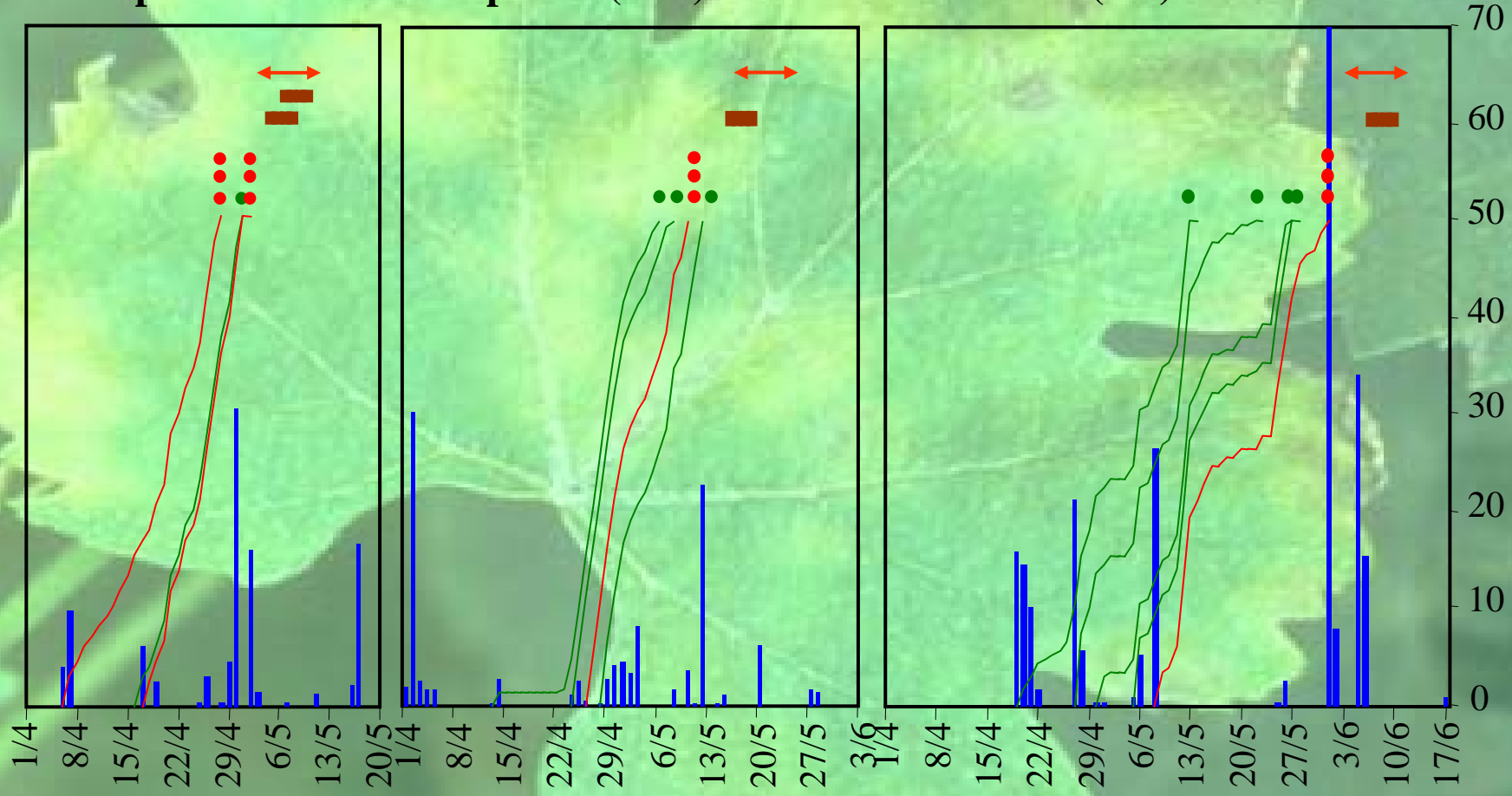
THE VALIDATIONS - Symptom occurrence

Correct predictions

Oltrepò PV 2001

Carpineta (MO) 1996

Panocchia (PR) 1997

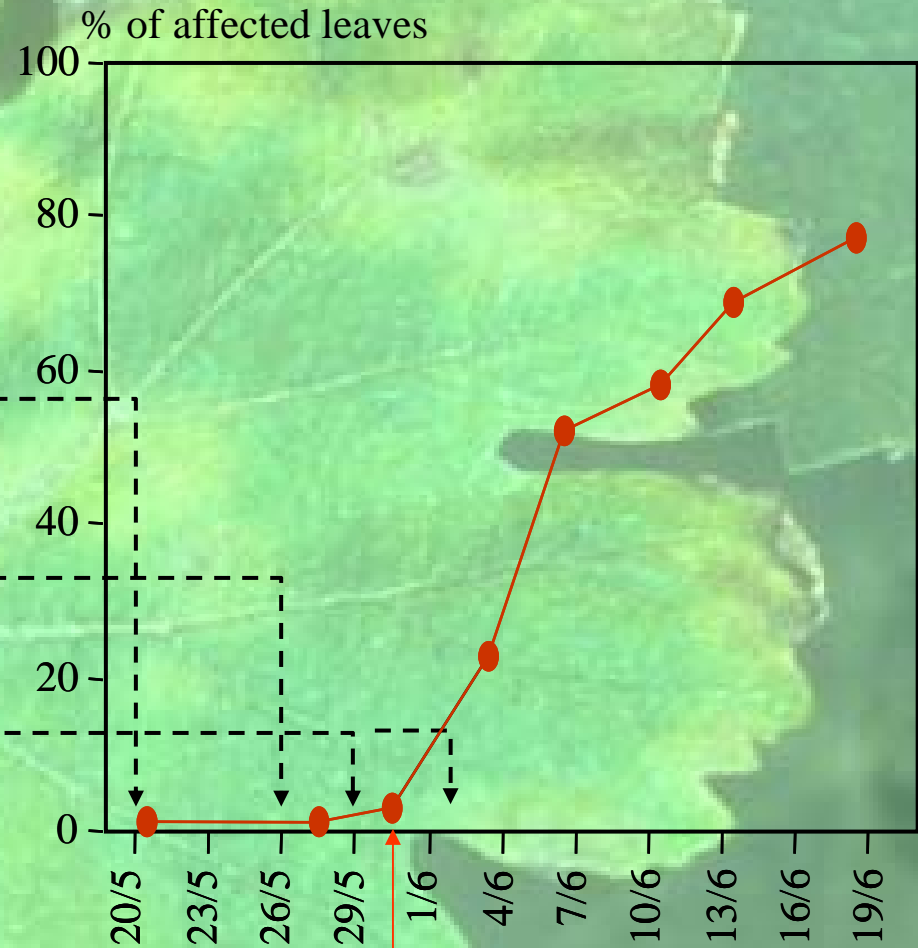


THE VALIDATIONS - Symptom occurrence

Alba (CN) 2002

Start of Germination	Oospores Germination	Infection	End of incubation
12/4	2/5	2-3/5	13-16/5
15/4	3/5	4/5	14-16/5
19/4	6/5	8-9/5	15-18/5
7/5	18/5	18-19/5	24-27/5
10/5	20/5	23-25/5	29/5-1/6
12/5	21/5	23-26/5	29/5-1/6
16/5	25/5	25-29/5	31/5-3/6
18/5	25/5	27-29/5	1-4/6

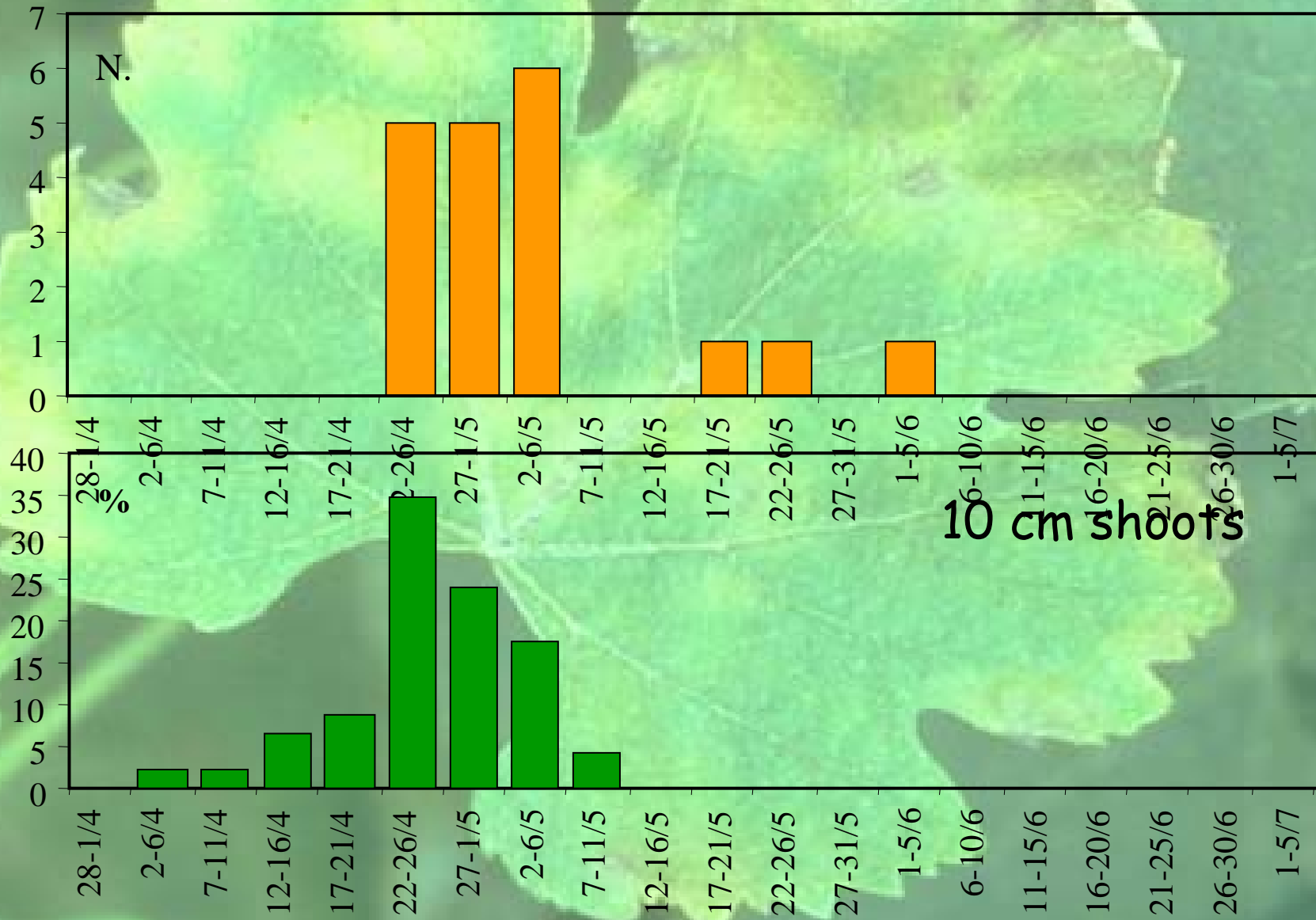
Correct predictions



sporulations

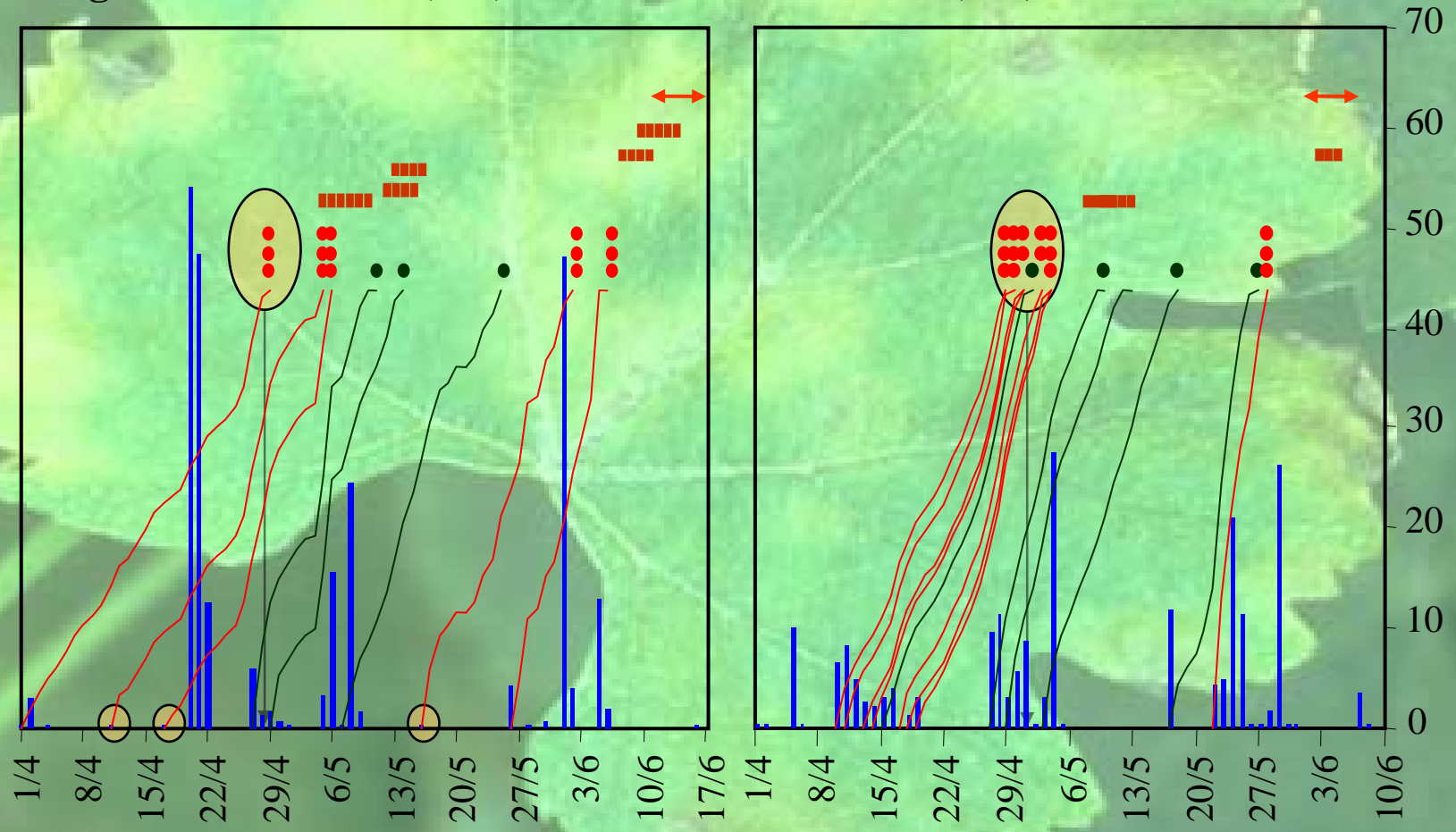
THE VALIDATIONS - Symptom occurrence

False alarms

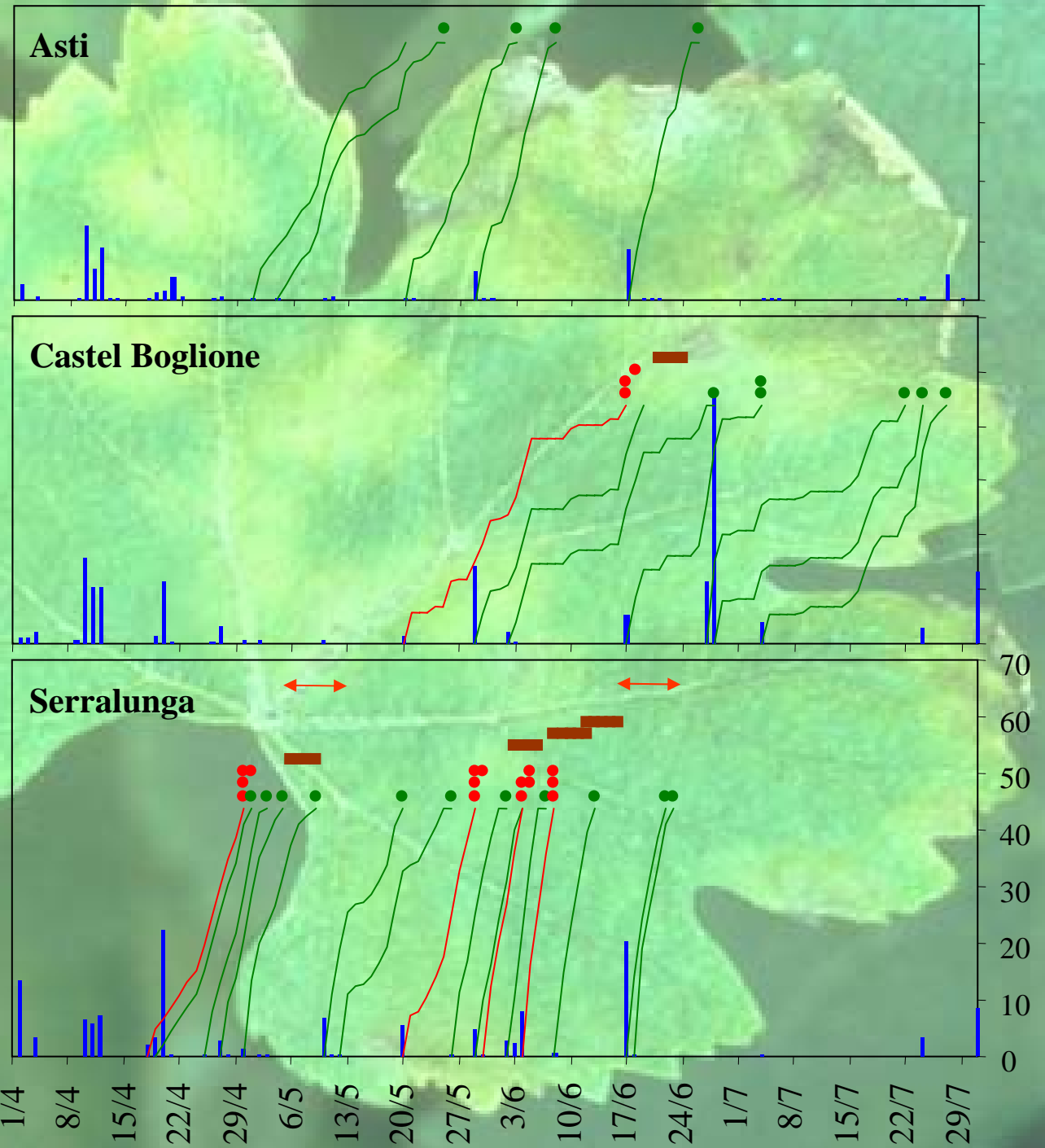


S.Agata sul Santerno (RA) 1997

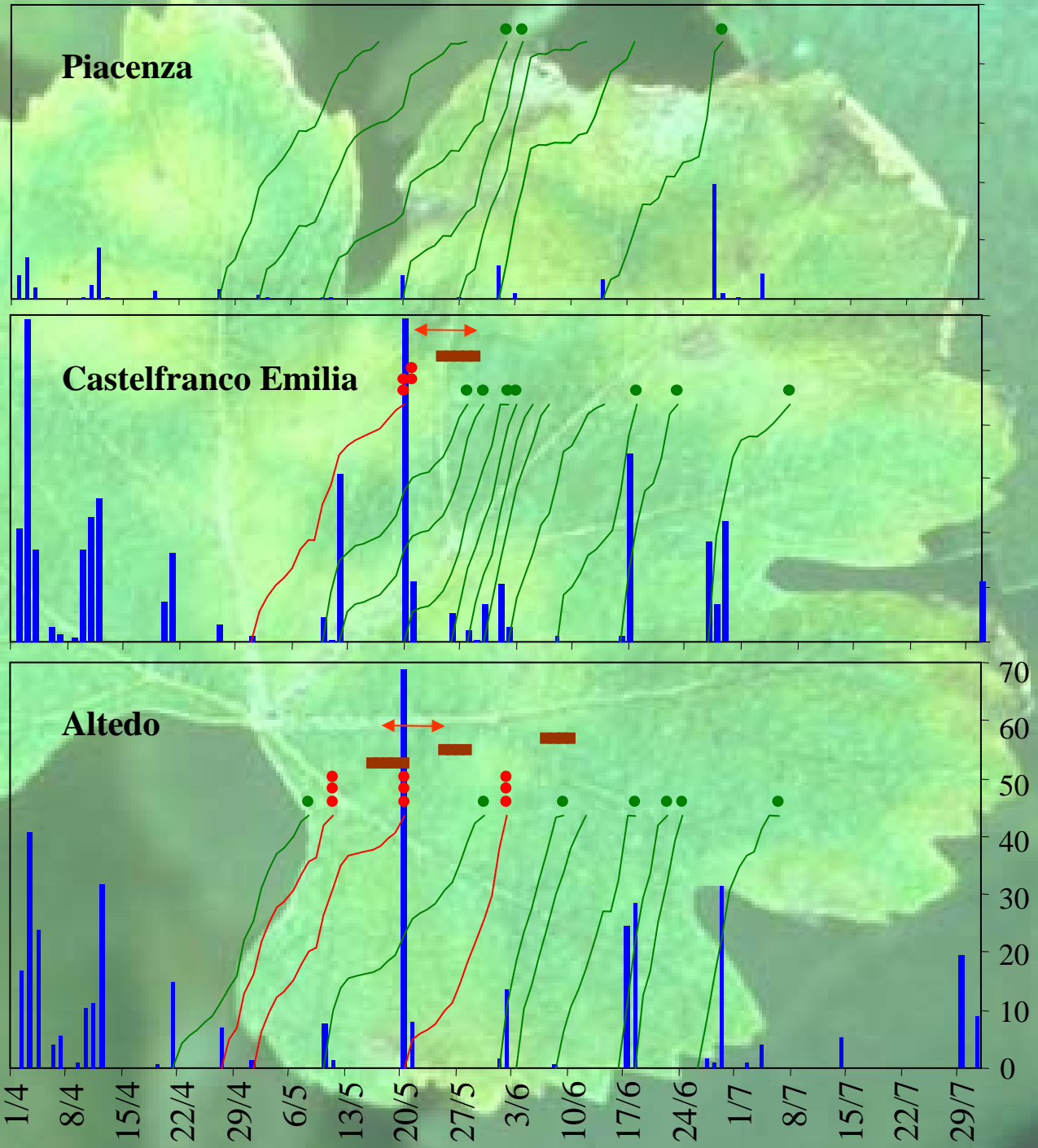
Lavezzola (RA) 1998



THE VALIDATIONS - Year 2003



THE VALIDATIONS - Year 2003



The forecasting model proved to be:

detailed

It followed, step by step, the whole infection process

accurate

It correctly estimated 94% of the cases

It never provided wrong negative prognosis

robust

It estimate either early and late infections

It adapt itself with several epidemiological conditions

The model gave some false alarms and therefore it can be furtherly improved