



Changes in epidemiology and population structure of *P. infestans* in Finland 1847-2011



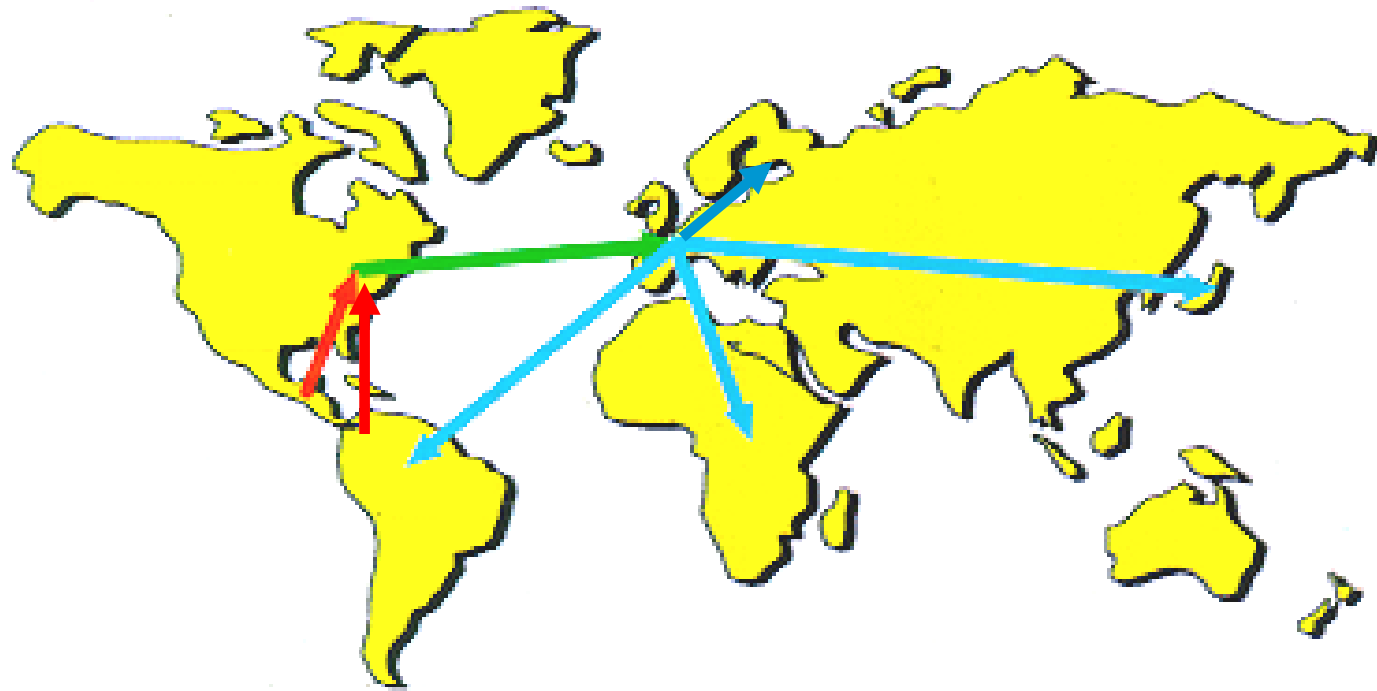
Asko O. Hannukkala
EuroBlight Workshop
14.5. 2013



Methods and data

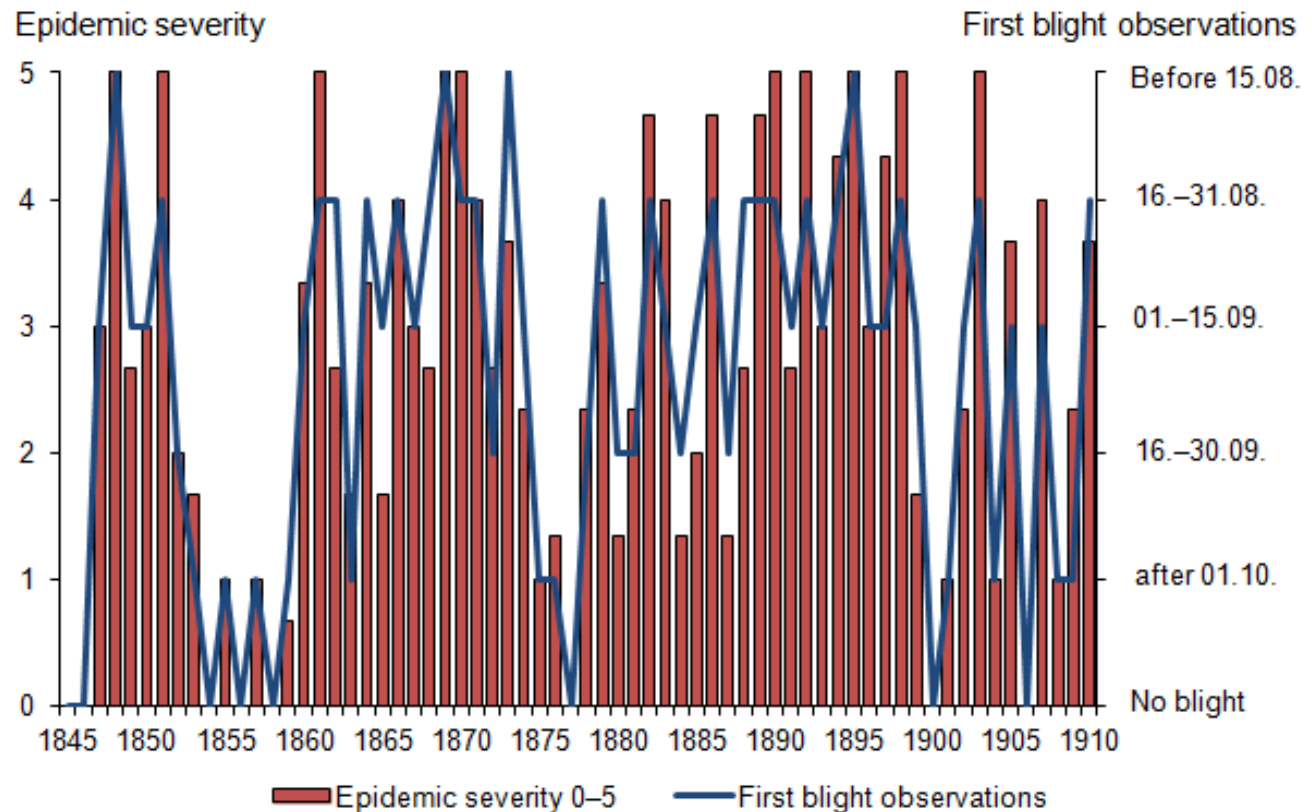
- **Review of newspaper articles (1845–1910) and research reports 1930–1980**
- **Monitoring late blight incidence and severity in variety and fungicide trials 1983–2011**
- **Determination of mating types, fungicide resistance and virulence races of *P. infestans* isolates 1990–2010**
- **Statistics of fungicide sales 1953–2010**

The first migration of late blight to Europe



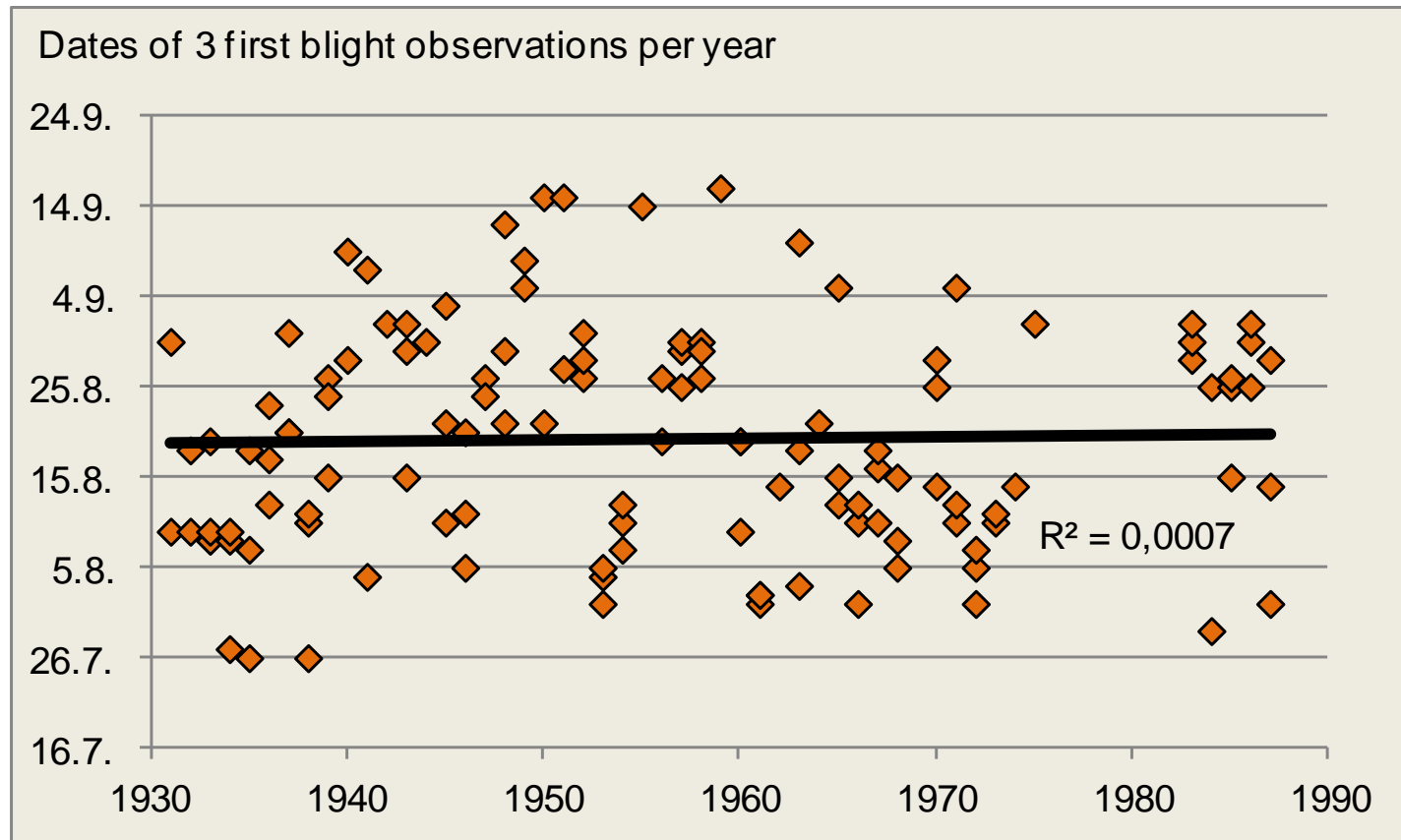
(After Goodwin et al)

Late blight in Finland from 1845 to 1910



- Tuber blight
- Availability of seed for the next season

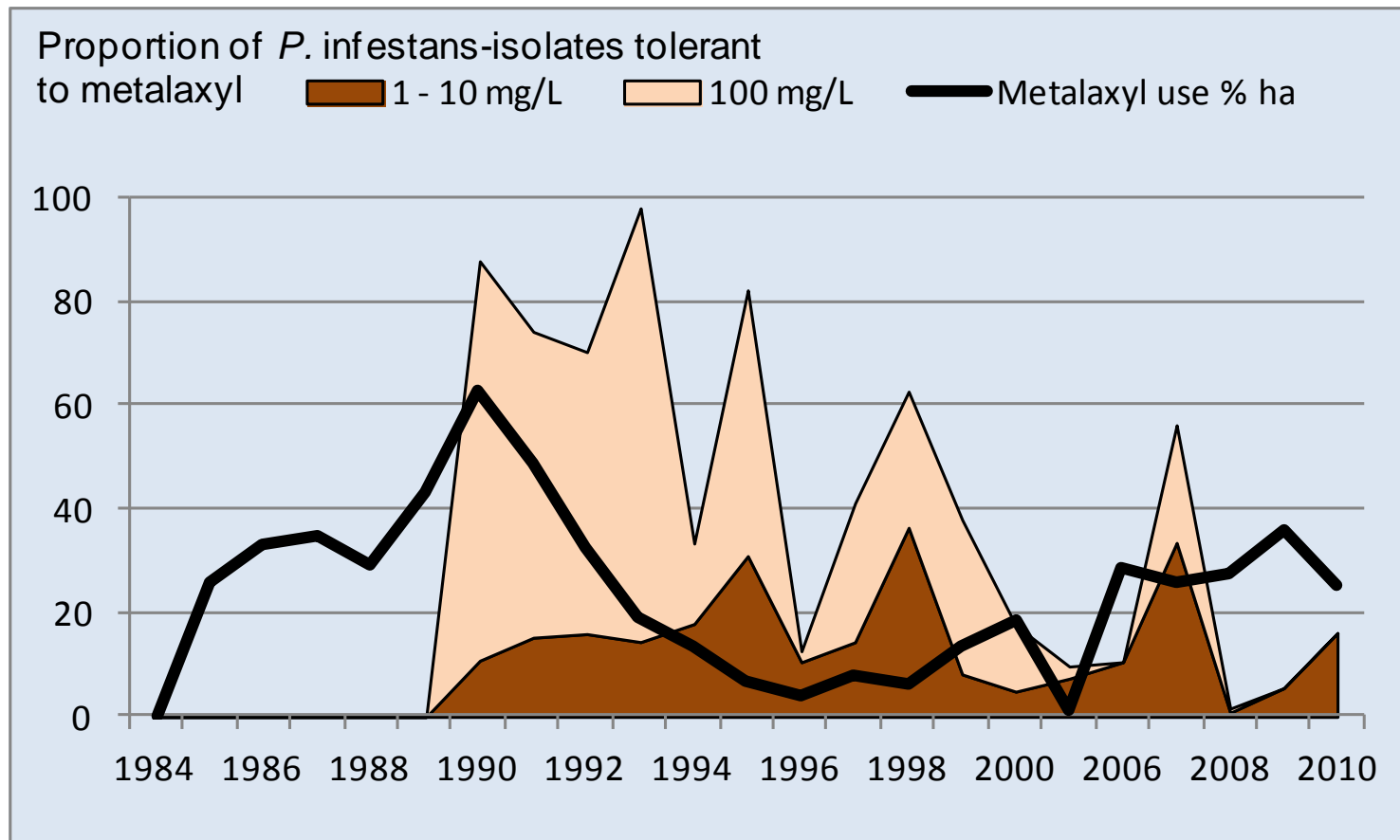
Late blight in Finland from 1930 to 1980s



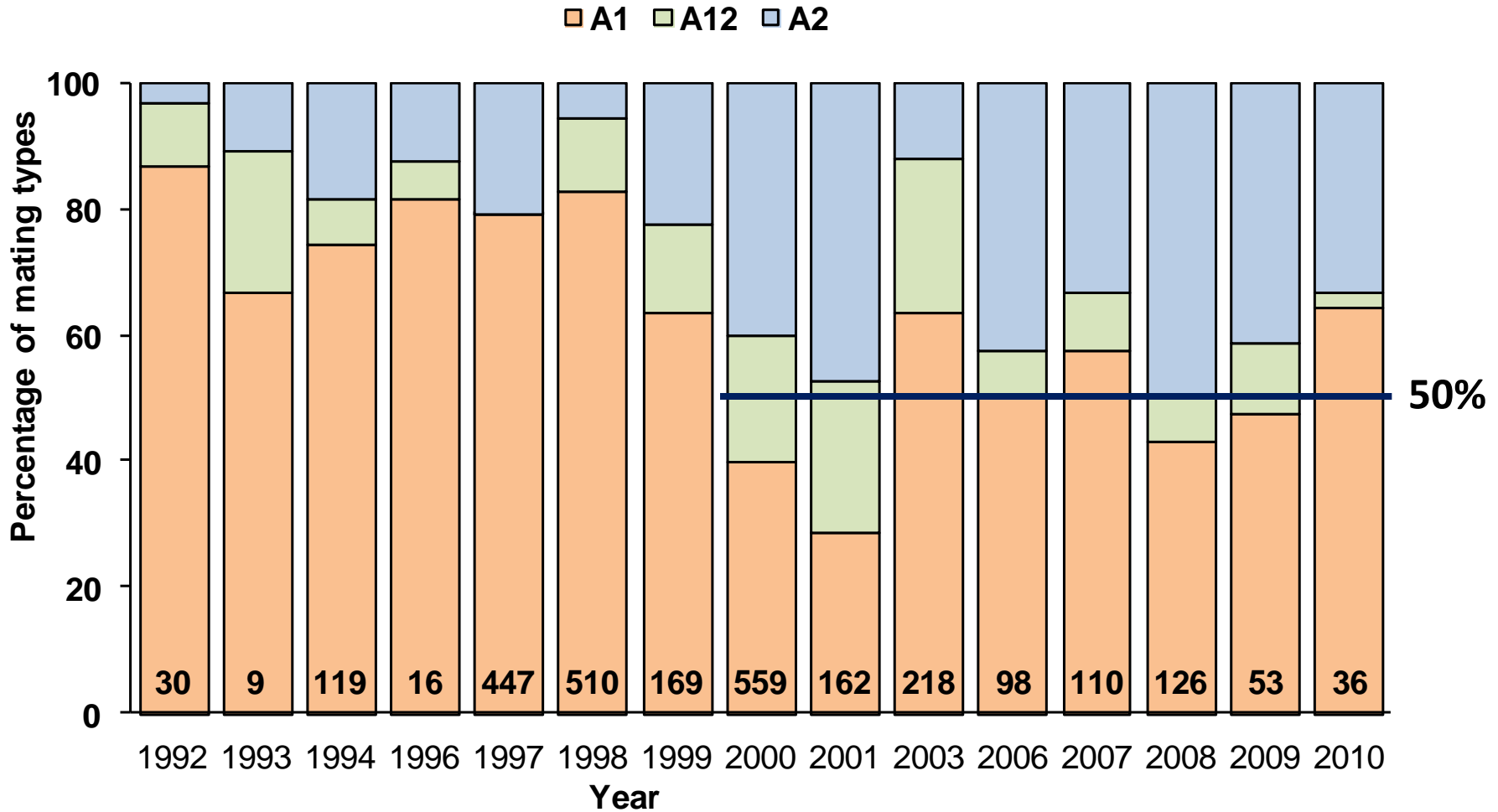
- **New systemic phenylamide fungicides were introduced 1985**
 - **“Fight against blight is over and the disease is now of no importance, if 2–3 fungicide applications are made”**

... but the fight was not over

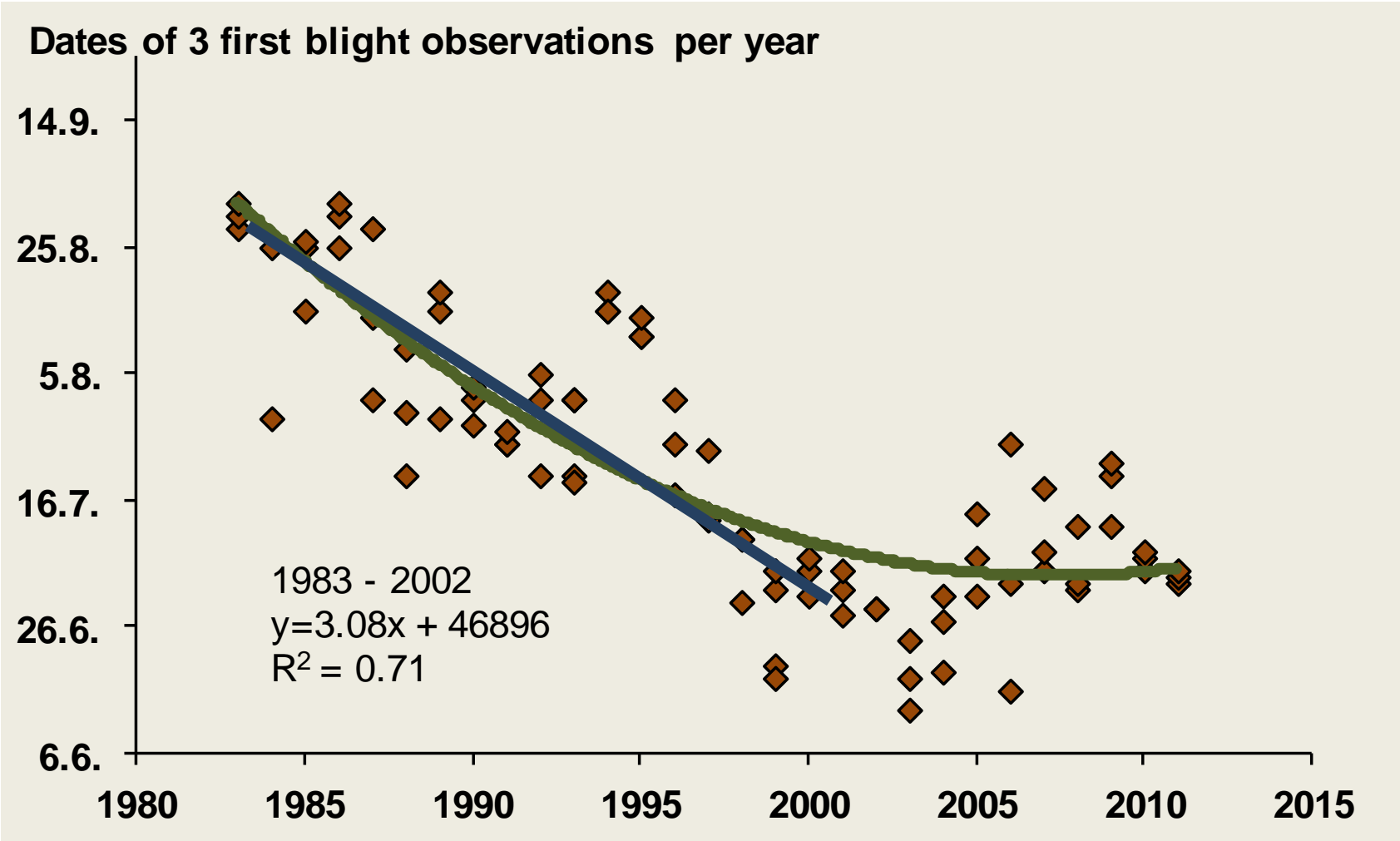
- At the end of the 1980s total failures in blight control with phenylamides were frequently reported
 - Most *P. infestans* isolates were fully fungicide resistant



Following years also mating type A2 appeared



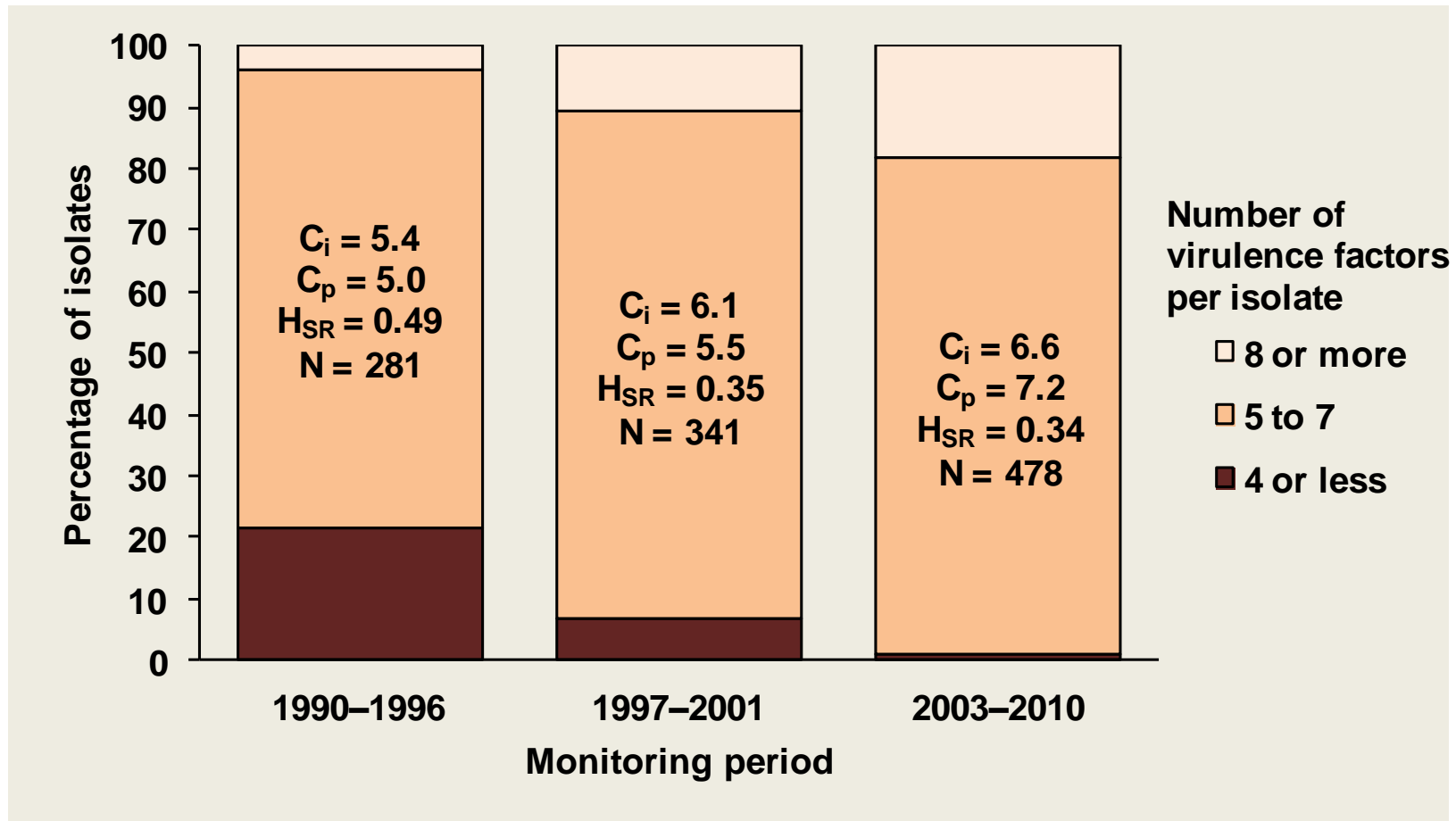
Onset of epidemics became 5 weeks earlier



New types of early attacks



Diversity and complexity of virulence races



Genotypic diversity

Table 2 – Genotypic diversity (single and multilocus) of *P. infestans* isolates from the Nordic countries collected in 2003.

SSR locus	Number of genotypes	N	Genotypic diversity ^a				
			Denmark (n = 49)	Finland (n = 50)	Norway (n = 50)	Sweden (n = 50)	Overall (n = 199)
Pi02	12	198	0.416	0.207	0.355	0.291	0.275
Pi04	6	191	0.262	0.311	0.211	0.299	0.211
Pi16	6	186	0.182	0.261	0.331	0.223	0.212
Pi26	15	195	0.445	0.379	0.445	0.507	0.375
Pi33	3	194	0.062	0.199	0.214	0.175	0.138
4B	6	199	0.362	0.425	0.460	0.373	0.301
4G	5	144	0.123	0.266	0.303	0.206	0.184
D13	16	139	0.341	0.403	0.224	0.479	0.321
G11	25	168	0.647	0.591	0.499	0.624	0.491
Multilocus ^d	169		0.903	1.000	0.936	0.966	0.954
			3.437 ^b	3.912 ^b	3.644 ^b	3.721 ^b	5.013 ^b
			0.945 ^c	1.000 ^c	0.969 ^c	0.989 ^c	0.977 ^c

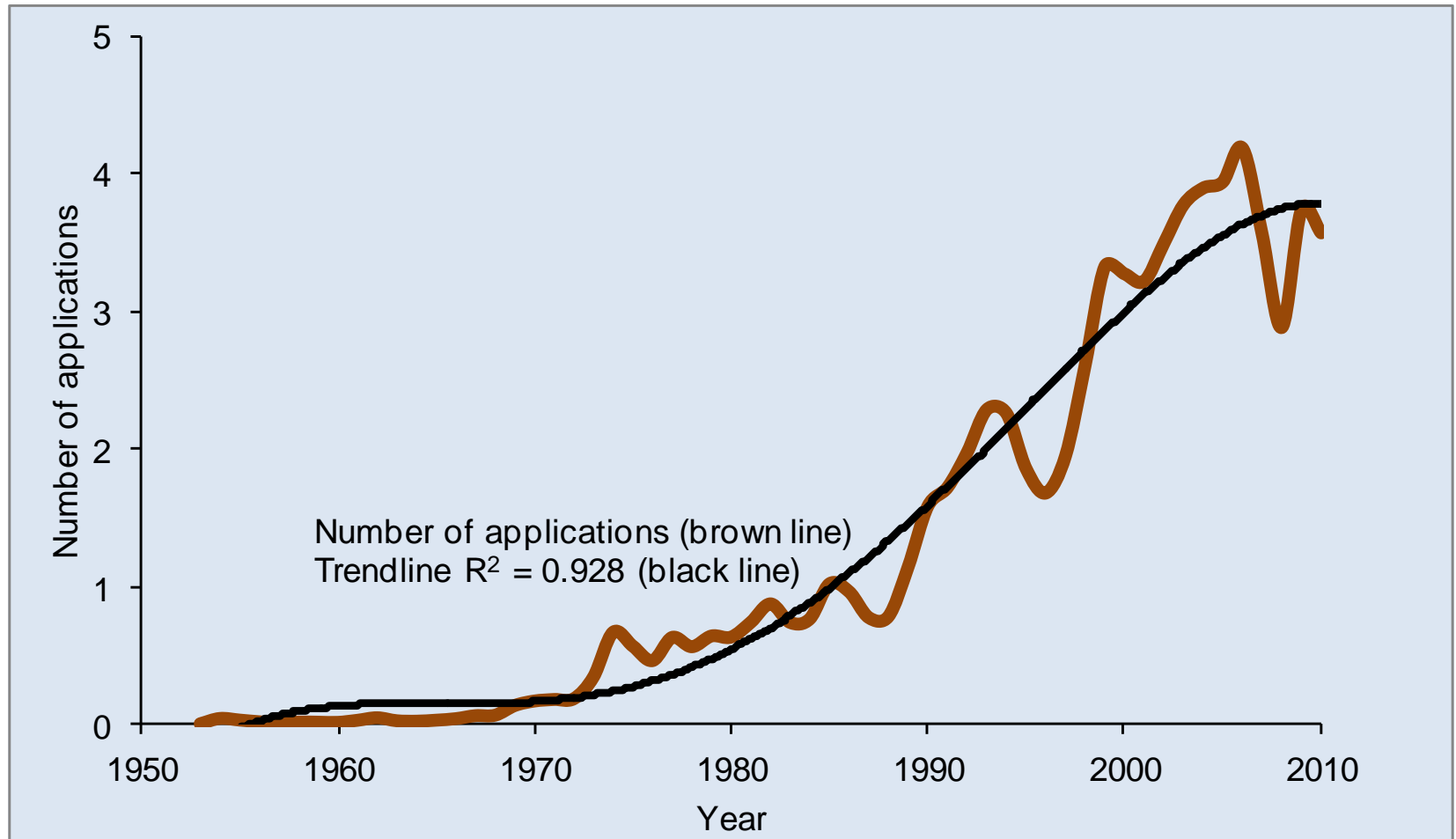
a Normalized Shannon index for all single loci and multilocus genotypes. The number of isolates analyzed from each country is given below each country name.

b Non-normalized Shannon index for multilocus genotypes in each country.

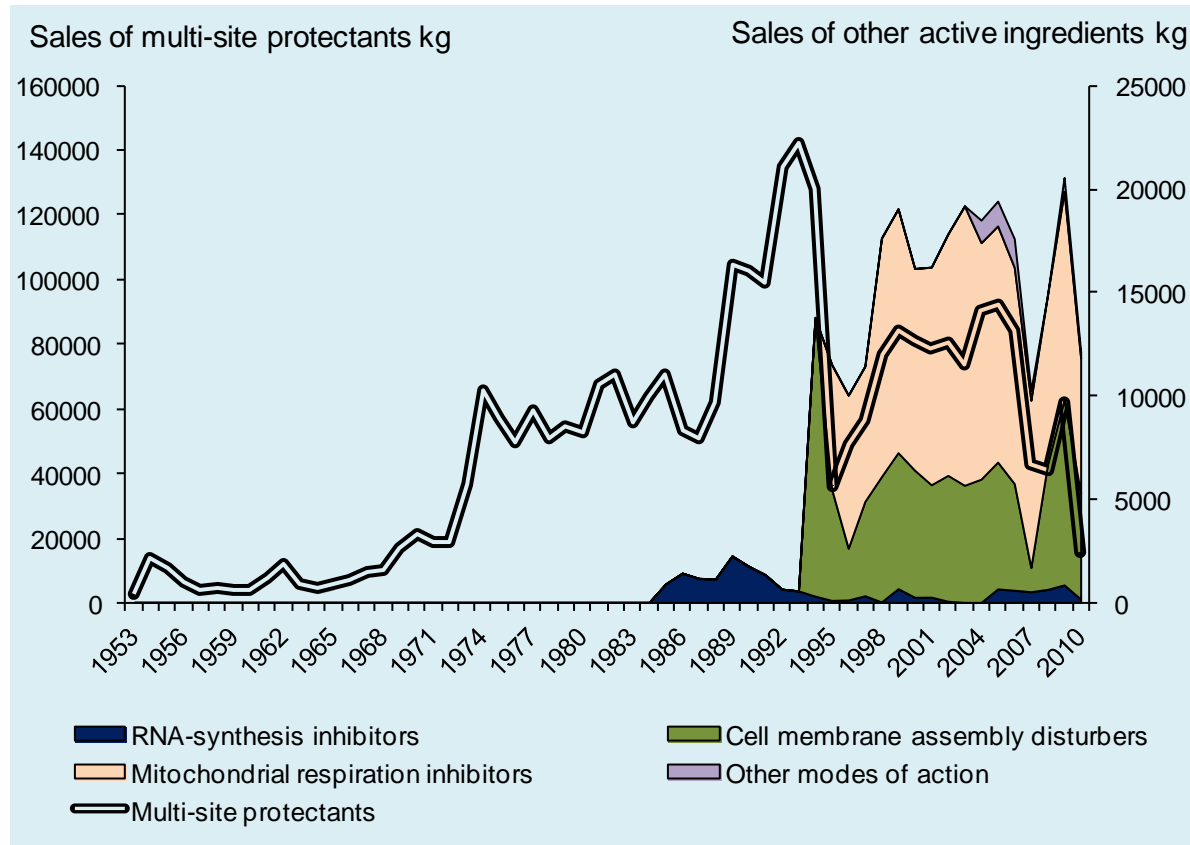
c Shannon index divided by number of genotypes.

d The multilocus genotype is based on the seven markers Pi02, Pi04, Pi16, Pi26, Pi33, 4B, G11 from 45, 50, 49 and 47 isolates from Denmark, Finland, Norway, and Sweden respectively.

Rapid increase in fungicide use



Introduction of several new fungicides



Conclusions and future prospects

- **Potato late blight is under control by current fungicides – blight will definitely provide surprises also in future**
- **EU pesticide legislation and reduced fungicide use provide challenges for future blight control**
- **Resistant cultivars are needed**
- **Cultural practices has to be changed – crop rotation**
- **Resources for monitoring should be provided also in future**