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Effect of host plant species and insecticides on the evolution of genetic diversity of a crop pest

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CONTEXT

Pesticides applications can be a strong driver of the evolution and genetic differentiation of pest populations. Pesticides use varies between crops and over time according to marketing authorization. A better understanding of the evolution and spread of pesticide resistance alleles in populations is a major challenge for pest management.

BIOLOGICAL MODEL

- *Myzus persicae* (Sulzer 1776)
- Generalist (>50 crop species)
- Multi-resistant to most insecticides
- Holocyclic and anholocyclic populations
- Sexual phase on peach trees (primary host) and asexual phase on many plants (secondary hosts)



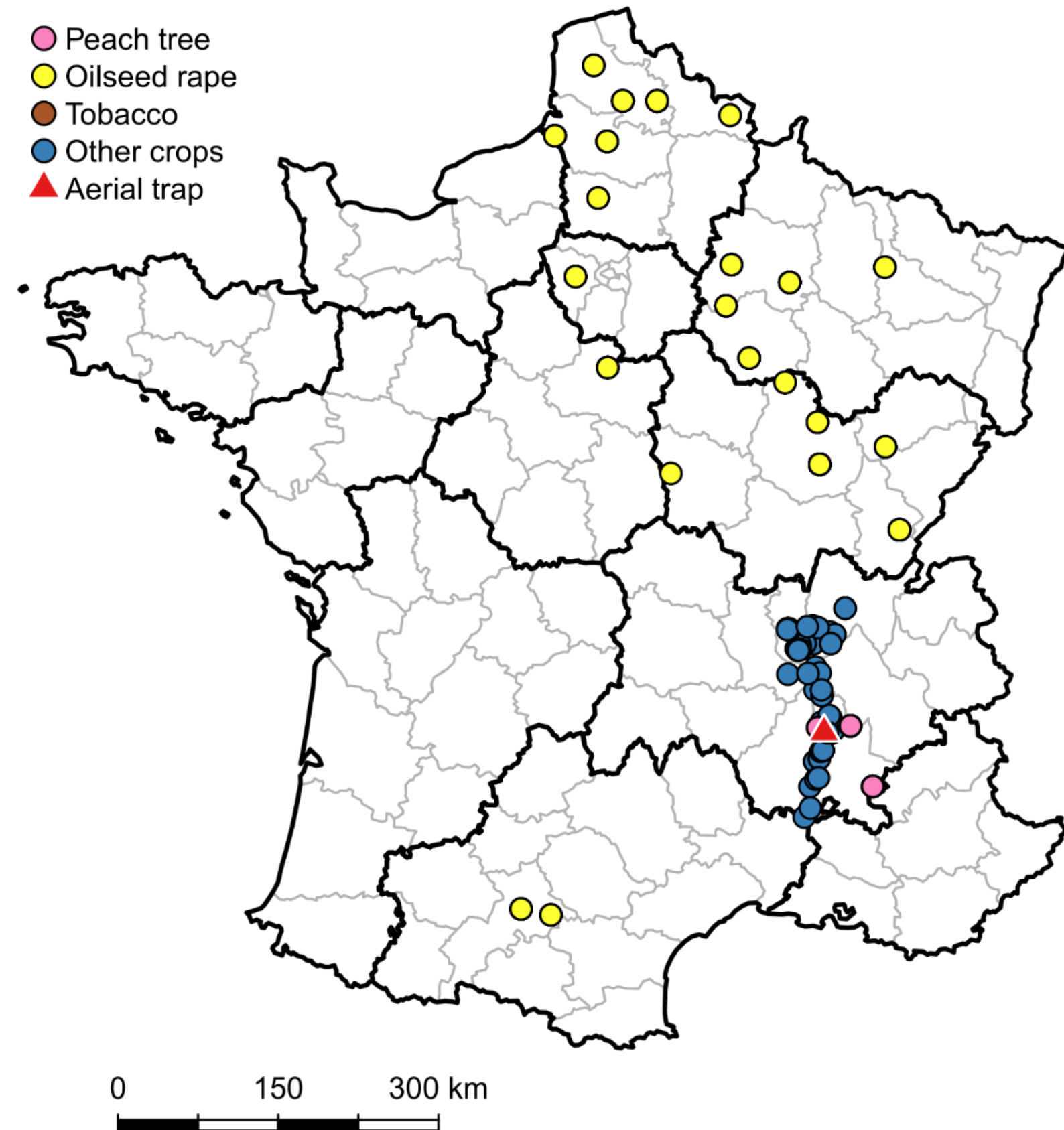
MATERIAL AND METHODS

- Two sets of samples :
 - From various host plants → identified crop species peach / oilseed rape / tobacco (+14 other)
 - From aerial trap → temporal sampling 2001-2007
 - 14 microsatellite markers
 - 4 target site resistance loci
 - 1299 successfully genotyped individuals

RESULTS

Individual based genetic analyses

Map of the sampling sites

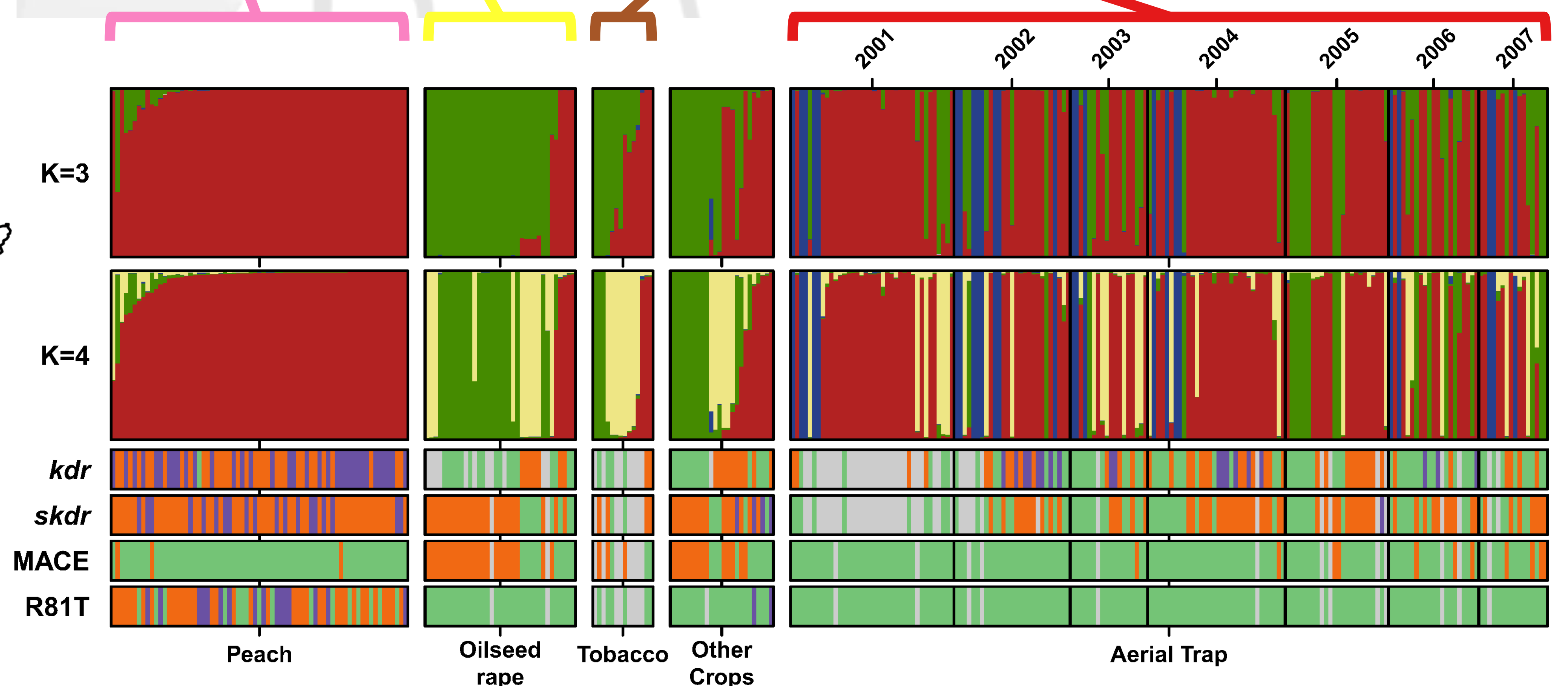


- four well defined neutral genetic clusters
- 1 cluster associated with the primary host
- 2 clusters associated with secondary hosts
- 1 highly divergent cluster (likely *Myzus certus*, a closely related species)
- strong association between resistance genotype and genetic cluster

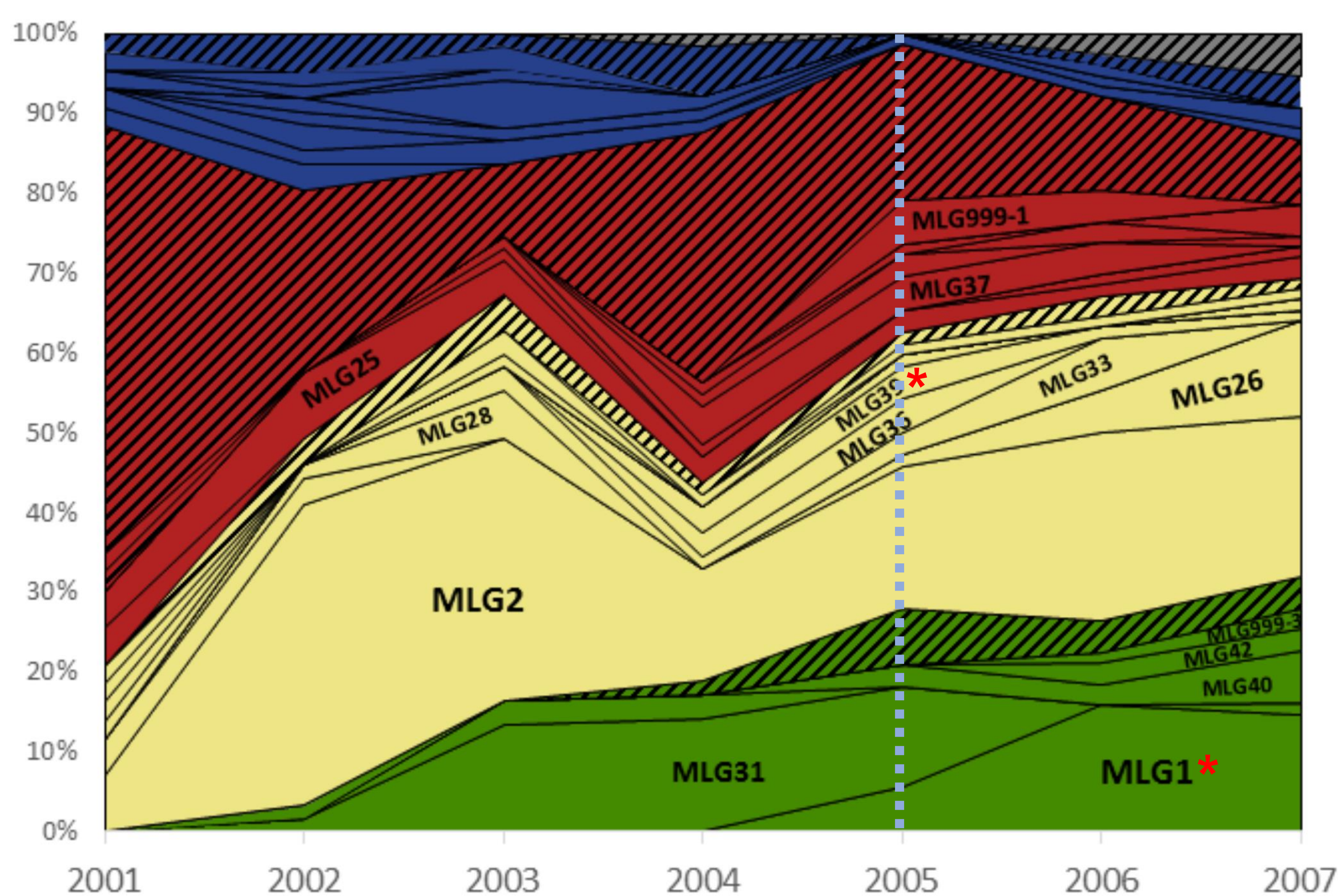


Individual genetic structure

The top two lines represent the Q-plot from STRUCTURE analyses for K=3 and 4, respectively. Each colors represent the proportion of the assignment to each cluster for each individuals. The 4 last lines depict the genotypes for the 4 target site resistance (TSR) loci: *kdr* and *skdr* loci are linked to pyrethroids TSR, MACE to pirimicarb TSR and R81T to neonicotinoids TSR: susceptible homozygote (light green), heterozygote (orange) and resistant homozygote (purple).



Temporal clonal dynamics



Temporal variation of multilocus genotypes (MLG) in the aerial trap

Genetic cluster membership of MLG is indicated by the same colors as in the 4-K STRUCTURE analysis. Solid colors: repeated MLG. Shaded colors: unique MLG. MLG belonging to the resistotype RG2 (carrying both a pyrethroid and pirimicarb resistance alleles) are indicated by a red star. Vertical dashed light blue line: first record of recurrent control failures with carbamate in oilseed rape in France

- some persistent MLG
- rapid turn-over of MLG
- higher genotypic and genic diversity in the red and blue clusters
- emergence of a multi-resistant clone linked to control failure

CONCLUSIONS

- genetic differentiation strongly associated with host plant/reproductive mode and resistotypes
- a small number of generalist clones carrying resistance alleles and persisting over time
- an evolutionary dynamic driven both by biological capacities and human activities
- better understanding of the evolution of pesticide resistance in agricultural landscape necessary for a better control of pests

