MODELLING THE EFFECT OF MULTI-YEAR APHID INFESTATION OVER FRUIT PRODUCTION

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- Transmission of viral diseases
- Reduction of vegetative growth
- Reduction in fruit production ?

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- Field experiments in 2005-2006 (Grechi *et al*. 2008 *Ent. Exp. Appl*.)
- Modelling 1 year dynamics (Grechi *et al*. 2010 *Ecol. Modell.*)
- Modelling multi-years dynamics (Bevacqua *et al*. in prep.)

Field experiments in 2005-2006 (Grechi *et al.* 2008 *Ent. Exp. Appl.*)

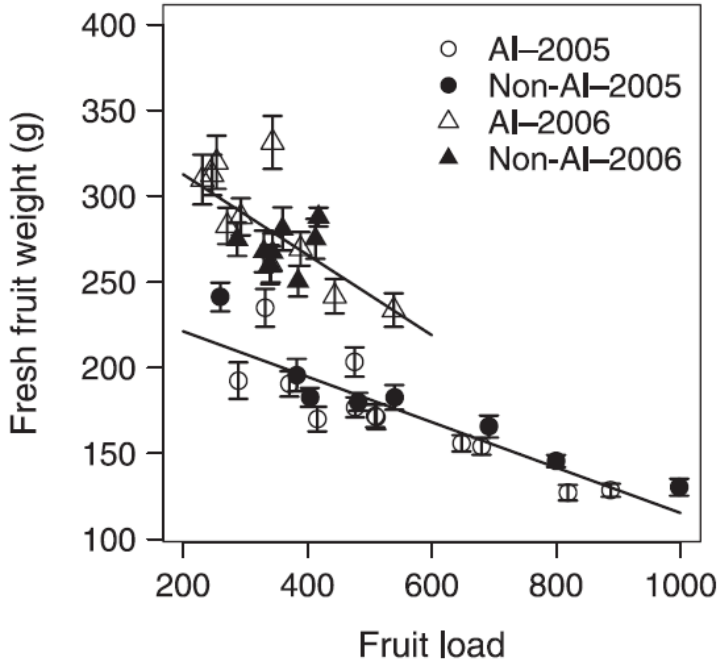

Figure 6 Relationship between average fresh fruit weight (g) and fruit load of-non-aphid-infested (non-AI) and *Myzus persicae* aphid-infested (AI) peach trees in 2005 and 2006. Lines are linear regression models. Vertical bars represent SEM.

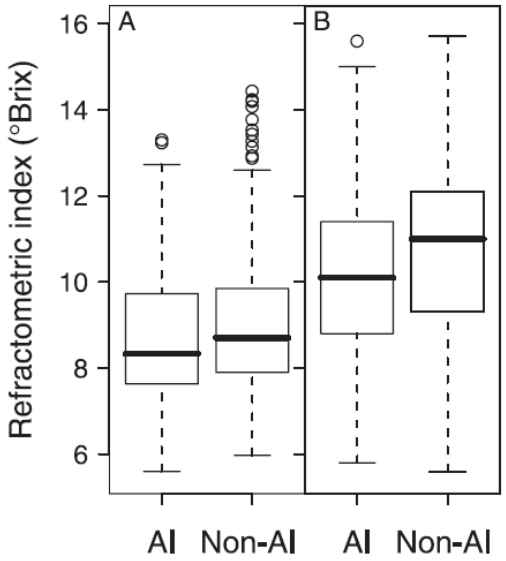

Figure 7 Boxplot distribution of refractometric index of the fruits sampled on peach trees of *Myzus persicae* aphid-infested (AI) and non-aphid-infested (non-AI) treatments in (A) 2005 and (B) 2006. Lower line, first quartile; line dividing the box, median; upper line, third quartile; open dots, outliers, that is, values that are more than 1.5*IQR lower than the first quartile and 1.5*IQR higher than the third quartile, where IQR is the interquartile range.

No significant differences in fruit quantity/quality between aphid infested AI and aphid free AF trees

Modelling 1 year dynamics (Grechi *et al.* 2010 *Ecol. Modell.*)

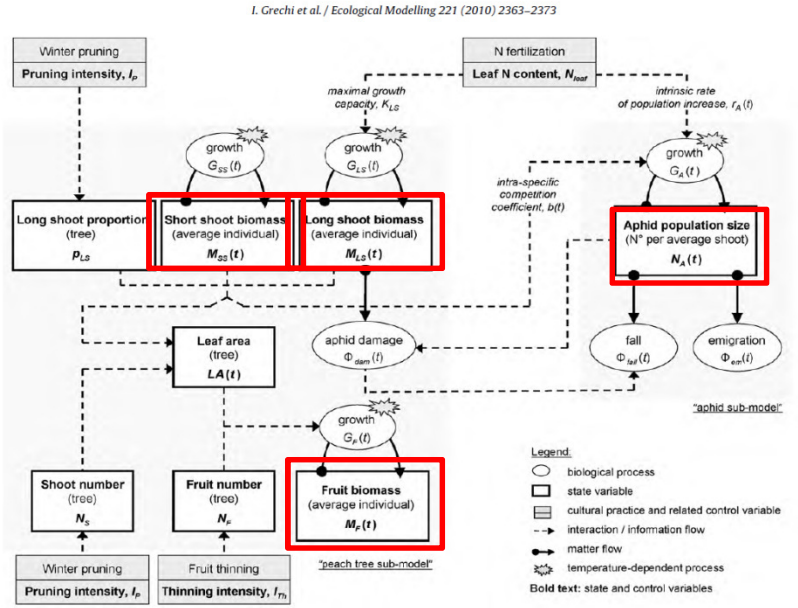

Fig. 1. Schematic representation of the peach–aphid model.

$$\begin{cases} \dfrac{dM_{LS}}{dt} = G_{LS}(t) - \Phi_{dam}(t) & \text{Mass of an average long shoots} \\ \dfrac{dM_{SS}}{dt} = G_{SS}(t) & \text{Mass of an average short shoots} \\ \dfrac{dM_F}{dt} = G_F(t) & \text{Mass of an average fruit} \\ \dfrac{dN_A}{dt} = G_A(t) - \Phi_{em}(t) - \Phi_{fall}(t) & \text{Abundance of aphids} \end{cases}$$

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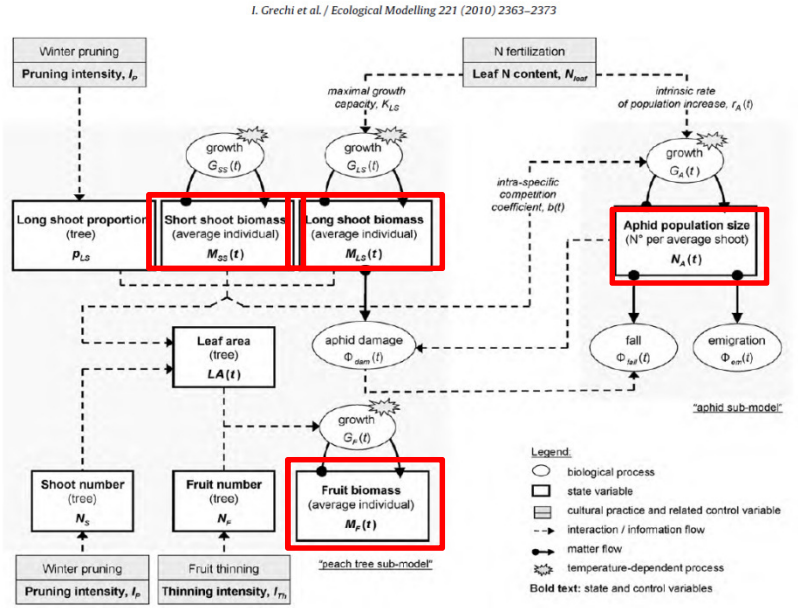

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Mass of an average long shoots

Mass of an average short shoots

Mass of an average fruit

Abundance of aphids

Differences in vegetative growth
No differences in fruit production

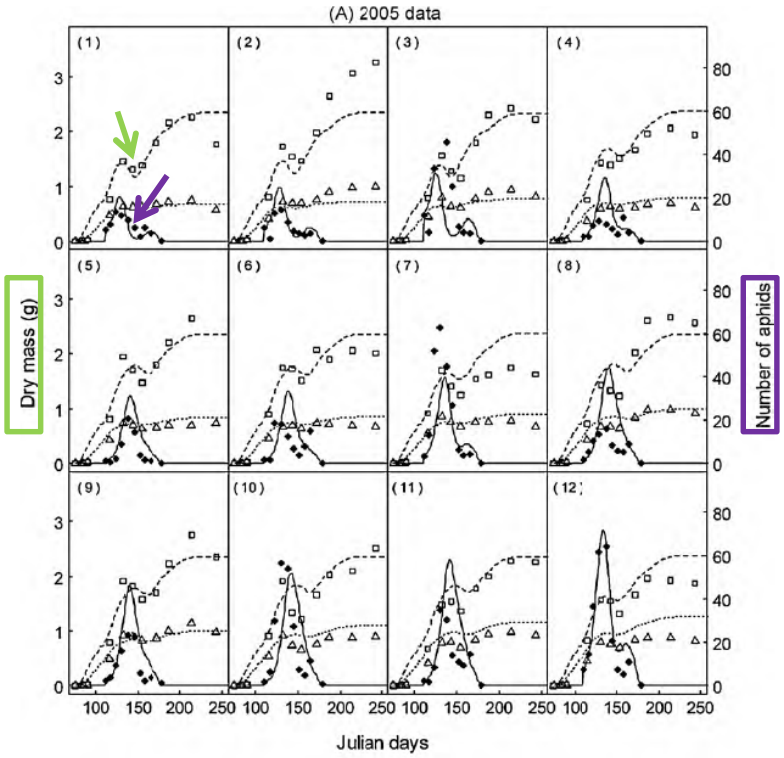
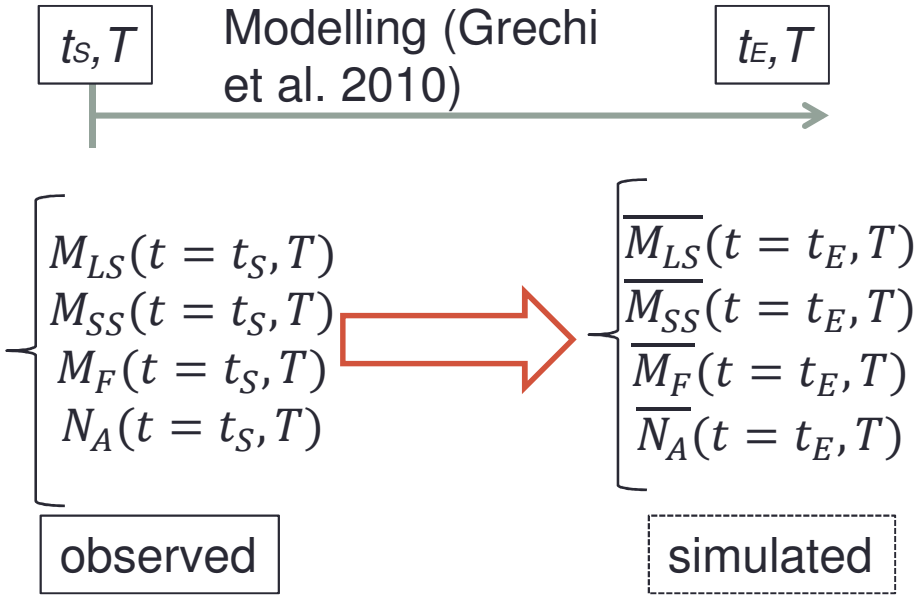


Fig. 3. Time course of the dry mass of a long shoot (□, - - -), of an average shoot per tree (Δ, ···), and of the number of aphids per average shoot (●, —) of 12 aphid-infested trees of 'Exp-A' in (A) 2005 and (B) 2006. Symbols are the mean of the observed values per tree. Lines are model estimations. Tree numbers are indicated between brackets.

Modelling multi-years dynamics



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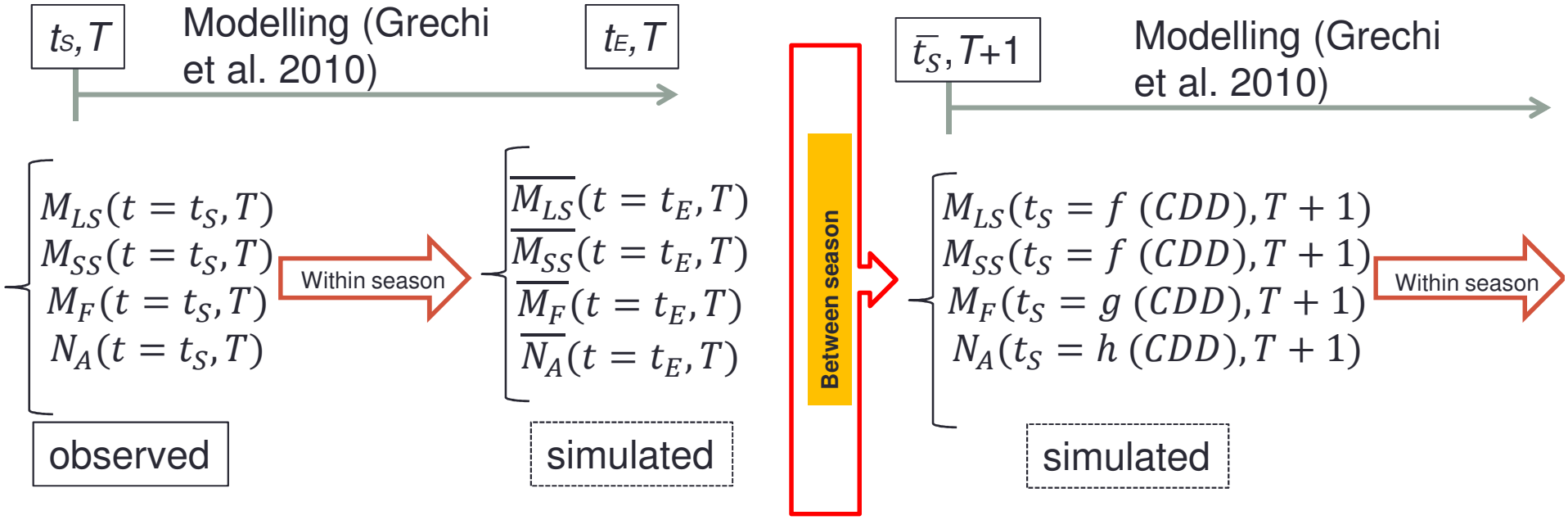

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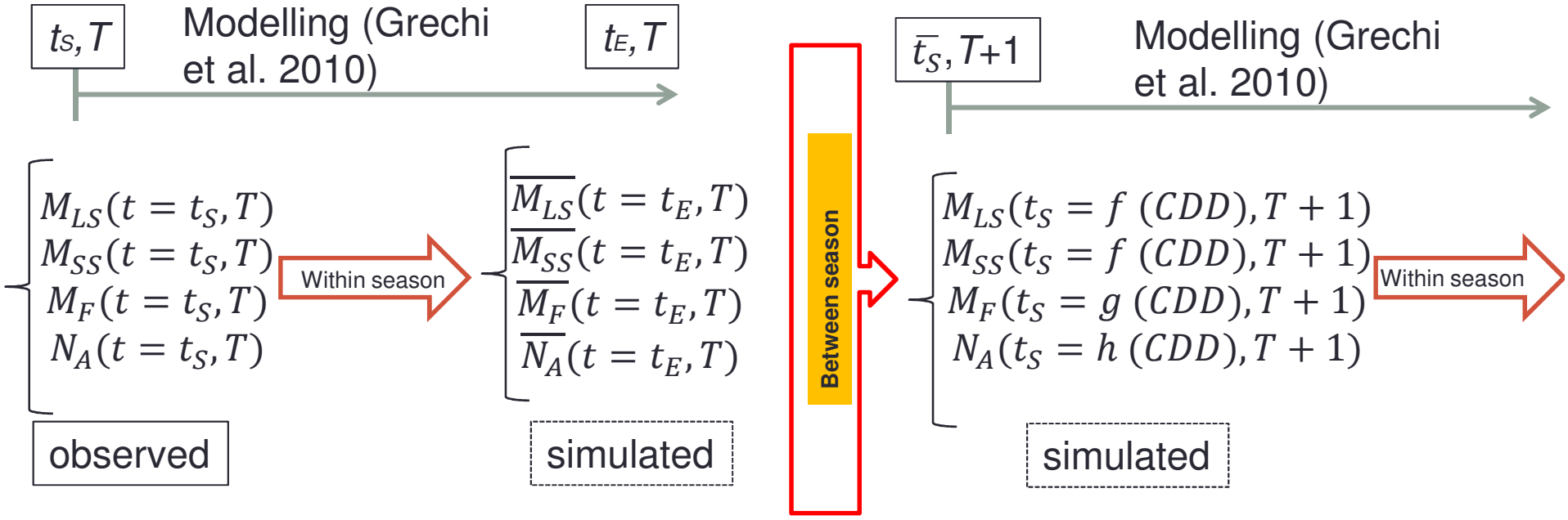
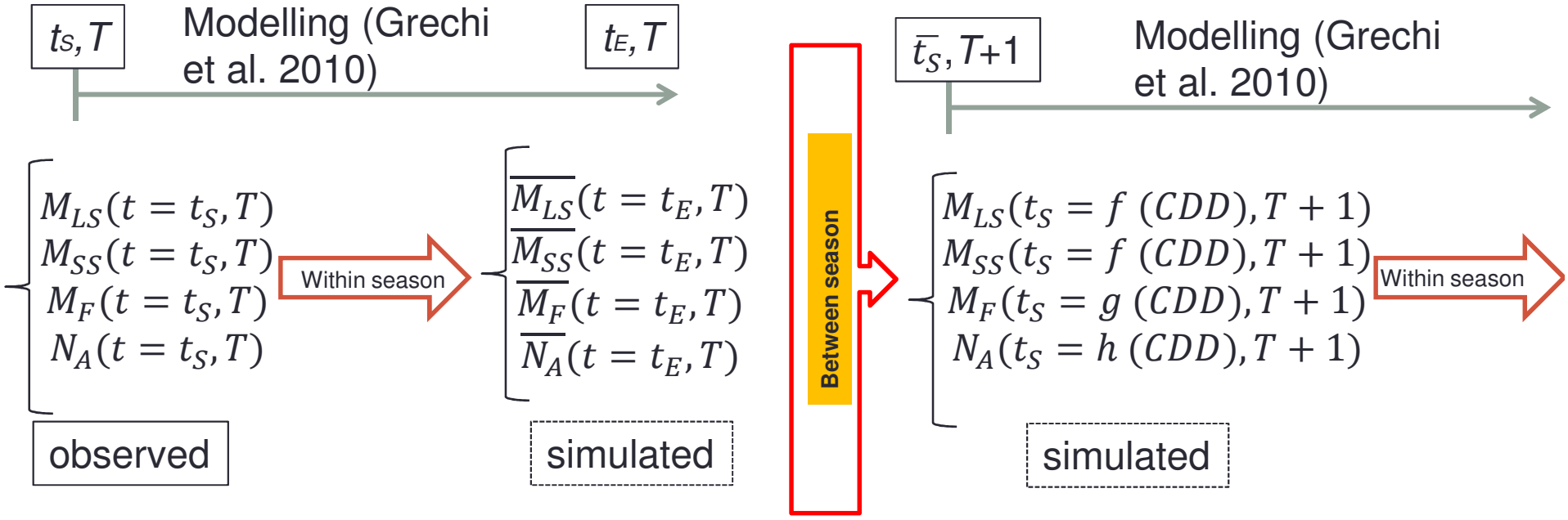


Between growing seasons dynamics as a function of env. & managm. variables

Between season

$$M_{LS}(t_S = f\ (CDD), T+1) = aM_{LS}(t_E, T) \times (1 - IP) \times pls$$
$$M_{SS}(t_S = f\ (CDD), T+1) = aM_{LS}(t_E, T) \times (1 - IP) \times (1 - pls)$$
$$M_F(t_S = g\ (CDD), T+1) = bM_{LS}(t_E, T) \times (1 - IP)$$
$$N_A(t_S = h\ (CDD), T+1) = c$$

Modelling multi-years dynamics



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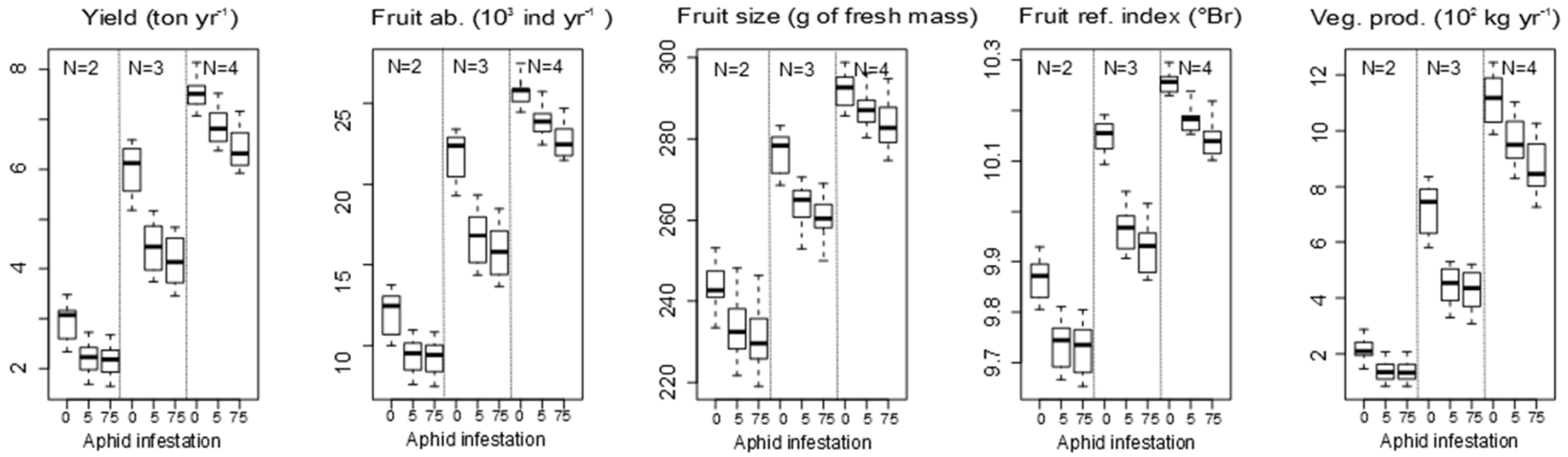
Virtual experiment

- Individual based model (i.e. each tree simulated from a given parameter set drawn from norm. distr)
- 10 simulated years
- 90 virtual orchards (60 trees each)
- 9 scenarios 3X3 aphid infestation & N fertilization levels (i.e. absent-low-high; low-average-high)
- 10 virtual replicates per scenario
- Environmental conditions of 2005

Results (summary over 10 yr)



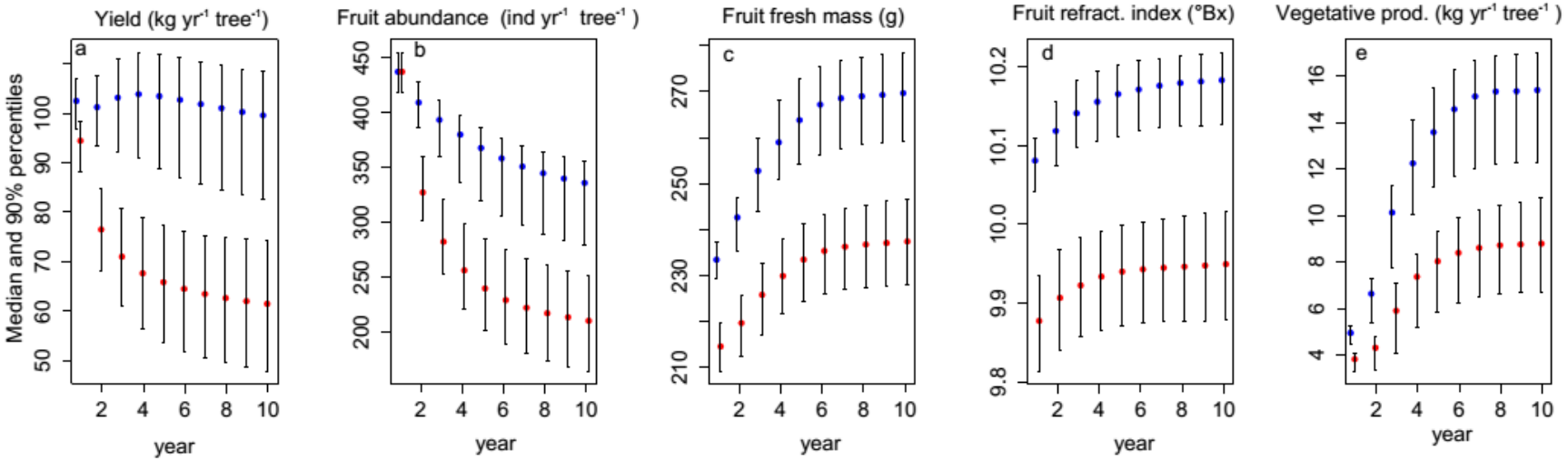
Long time (10 yr) aphids infestation and fertilization affect yield quantity & quality

Initial aphid infestation level does not matter

Fertilization level matters more than aphid presence

Results (temporal dynamics)

Average fertilization scenario (aphid free & highly aphid infested)



Aphid infestation consequences become more evident year by year

Aphids mainly affect production in year *t+1* by impairing vegetative growth in year *t*

Conclusions

- Long term simulations/experiments are needed to better understand plant-aphid dynamics
- Long term experiments are needed to confirm/contradict our findings
- Aphids damages could be negligible when effective cultural practices (i.e. winter pruning & fertilization) are applied

Acknowledgements

SEVENTH FRAMEWORK PROGRAMME

EcoHort
Vers des systèmes écologiquement innovants en horticulture

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