

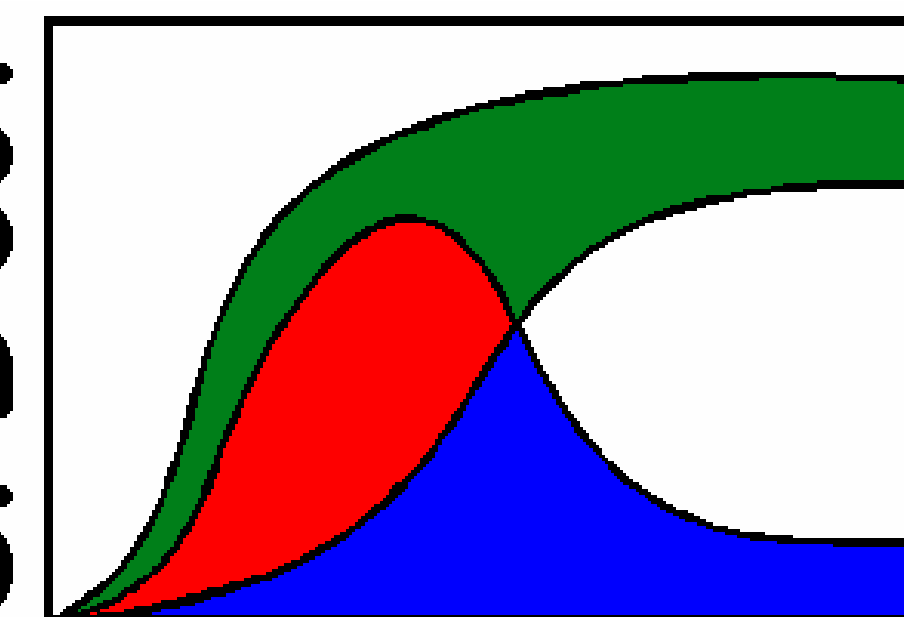
PLATHO (PLAnTs as Tree and Herb Objects)

A generic plant model of resource allocation

for growth and defense

C2

SFB 607



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Results and conclusions

- A new model for the simulation of resource allocation, in particular to the “defensive-compounds-pool” was developed
- Competition of plant individuals for external resources (light, water, nutrients) is considered by means of a dynamic modelling approach for plant morphology
- Effects of biotic and abiotic external factors on growth and resistance of plants can be reproduced by the model for different plants species and experiments
- If defence reactions are confined to single plant organs, the modelling level of plants as a whole is not accurate enough → plant structure should be explicitly considered

Model description

- PLATHO simulates resource allocation in woody and herbaceous plants by means of a single generic modelling approach
- PLATHO considers physiological processes with high time resolution and integrates dynamic physiological properties in single plants
- Plant internal physiological processes are governed by external abiotic and biotic external factors (e.g. CO₂, O₃, pathogenes)
- Several interacting plant individuals can be simulated simultaneously to describe inter- and intraspecific competition
- The simulation program is highly modular, single components of the model can be included, omitted or substituted to test different working hypotheses

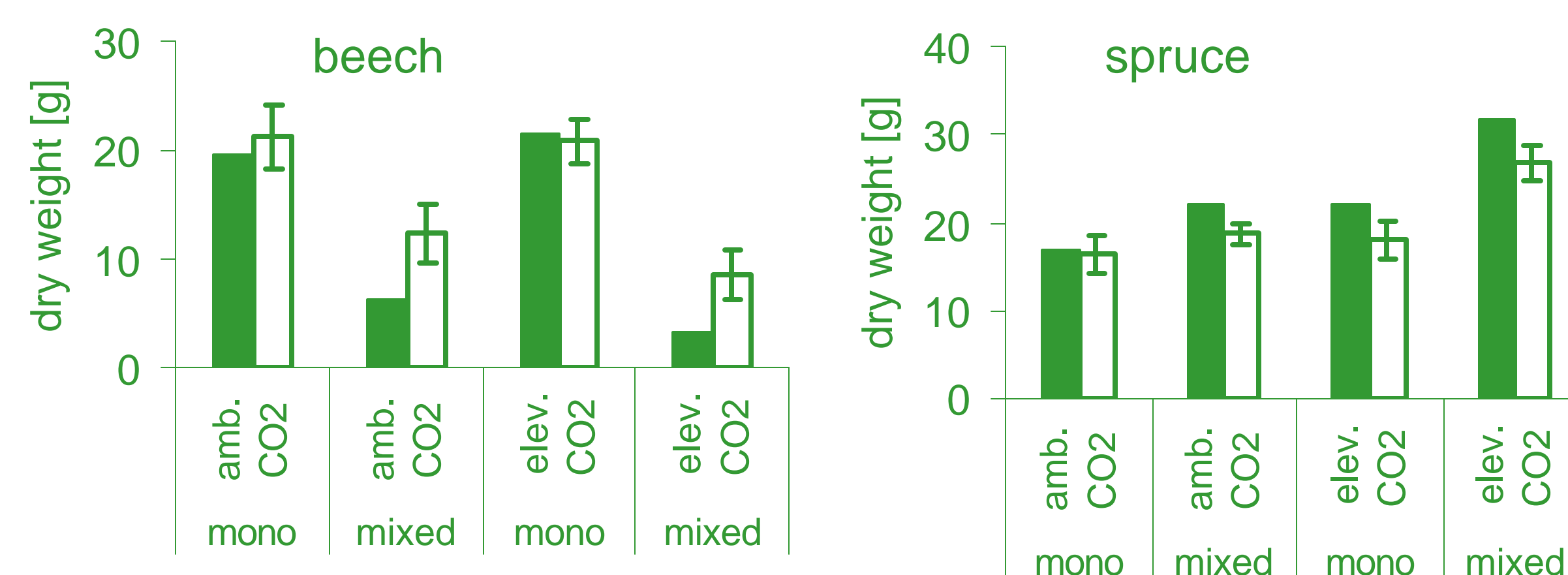
Model application and evaluation

The main focus of Phase II was the further development of the model and the evaluation of the new modelling approaches using data from SFB-projects

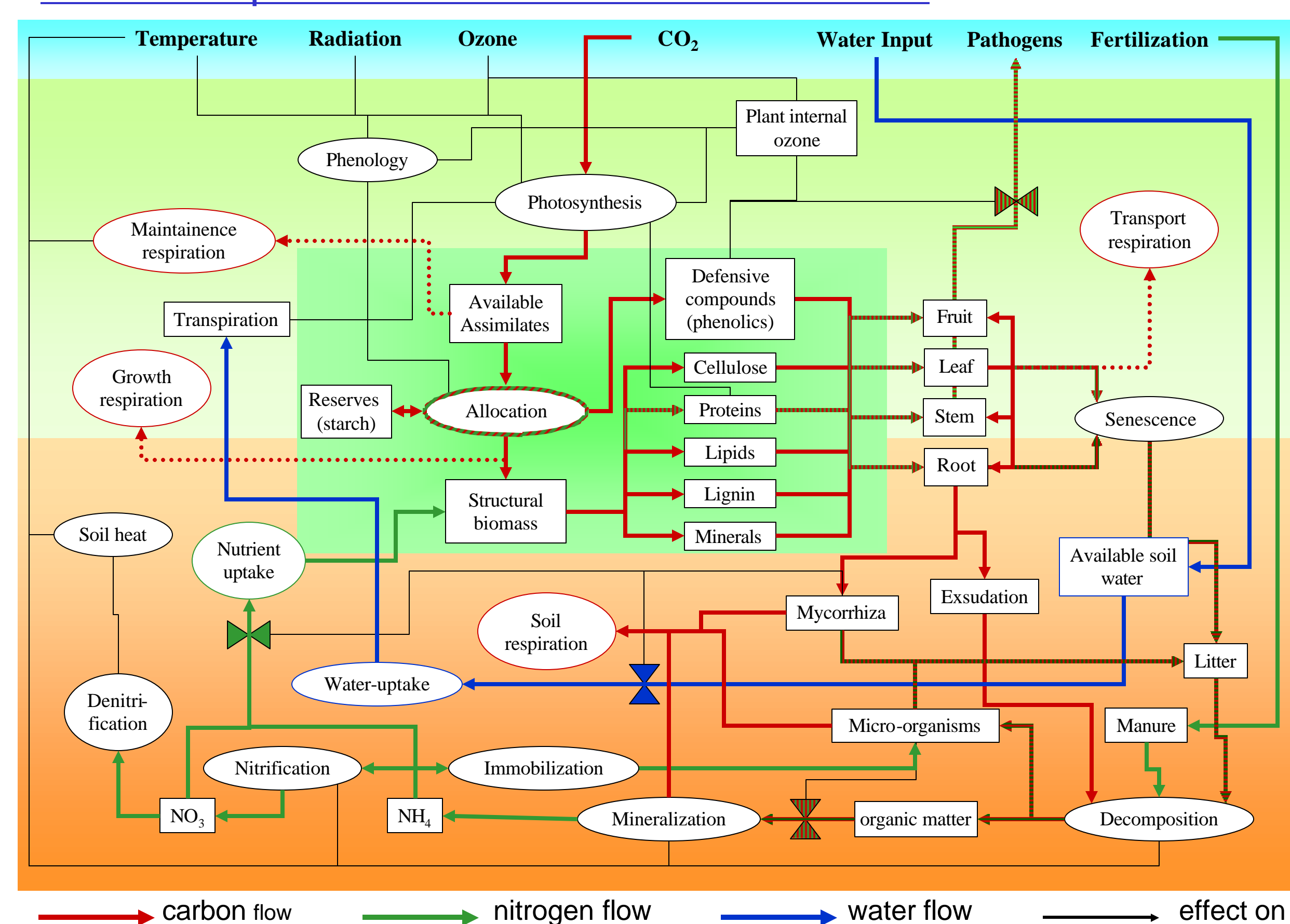
Examples:

a) Interspecific competition

Simulated (closed bars) and measured (open bars) dry weight increment of non-green above ground biomass for mono- and mixed cultures of young beeches and spruces over two vegetation periods (data from B5):

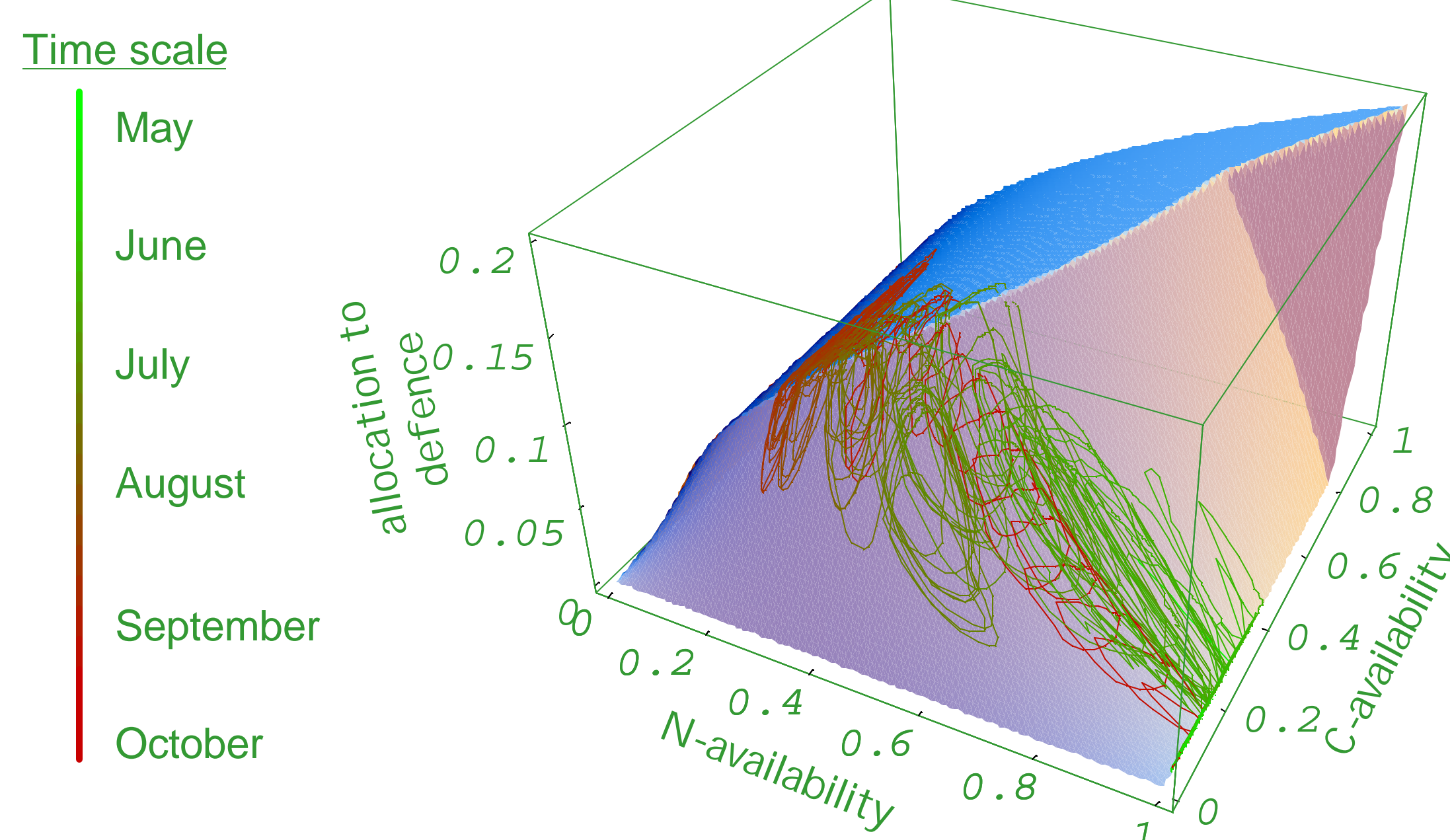


Pools and processes considered in PLATHO:

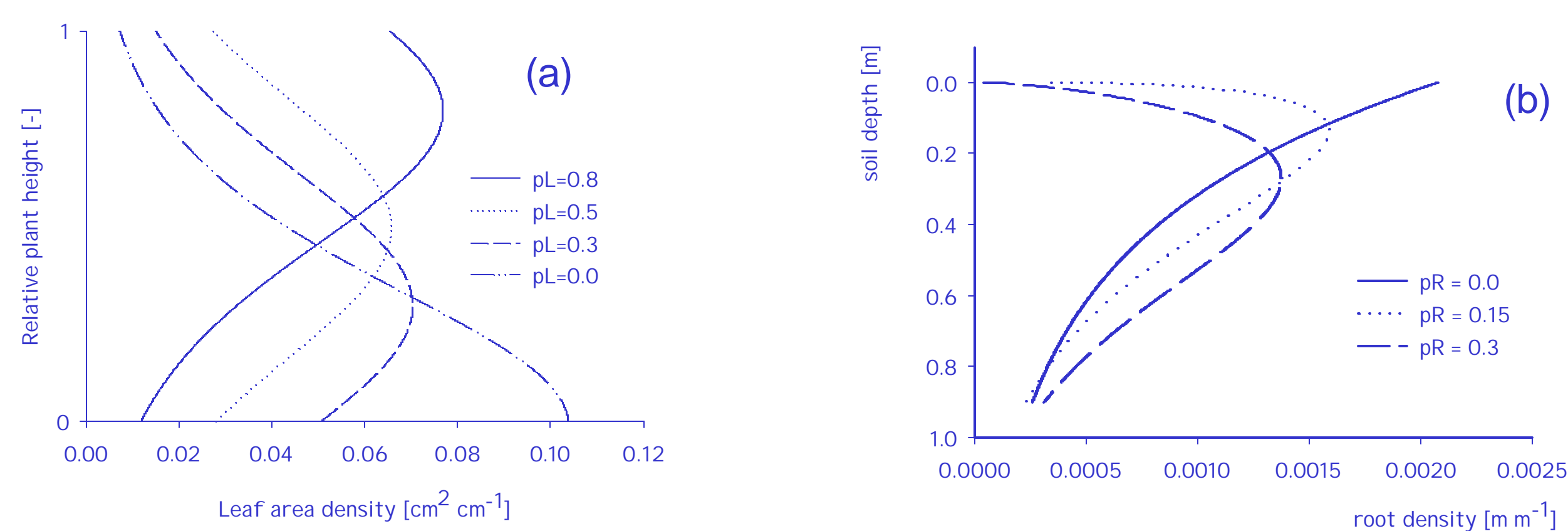


b) Environmental effects on the formation of defensive compounds

Simulated dynamics of resource allocation into defensive compounds during one vegetation period in a scenario for young apple trees. Allocation to defence strongly depends from actual plant internal availability of carbon and nitrogen.

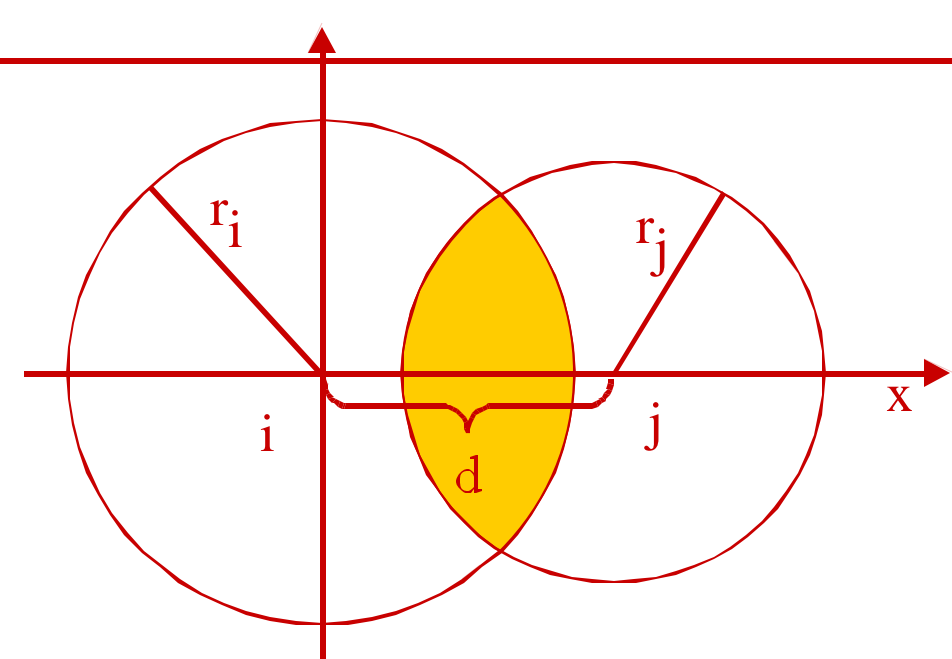
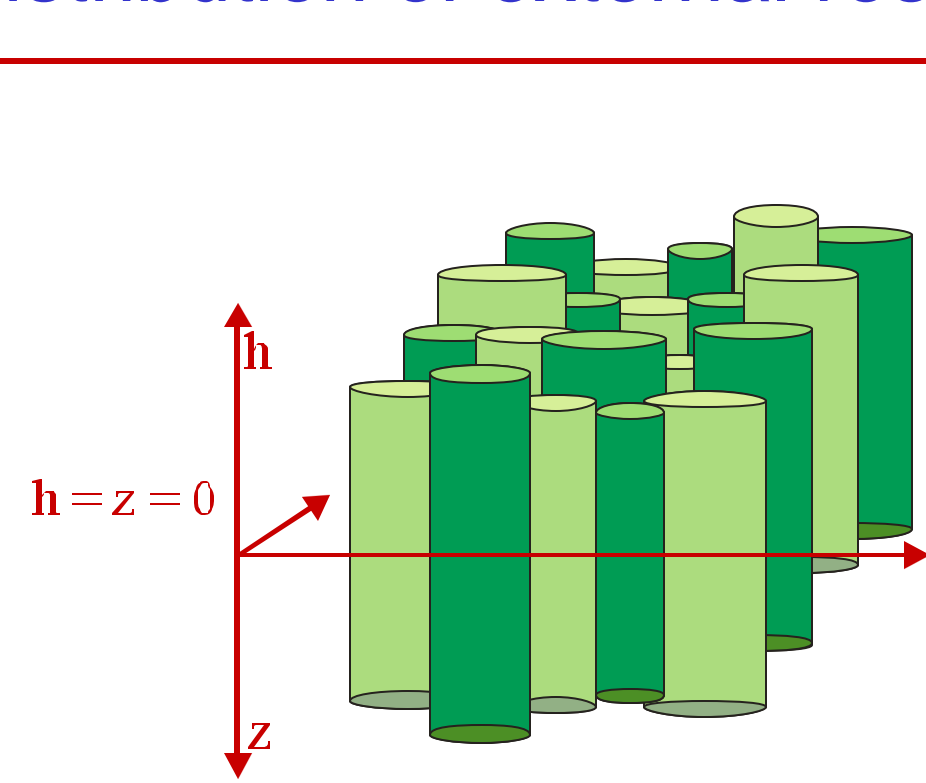
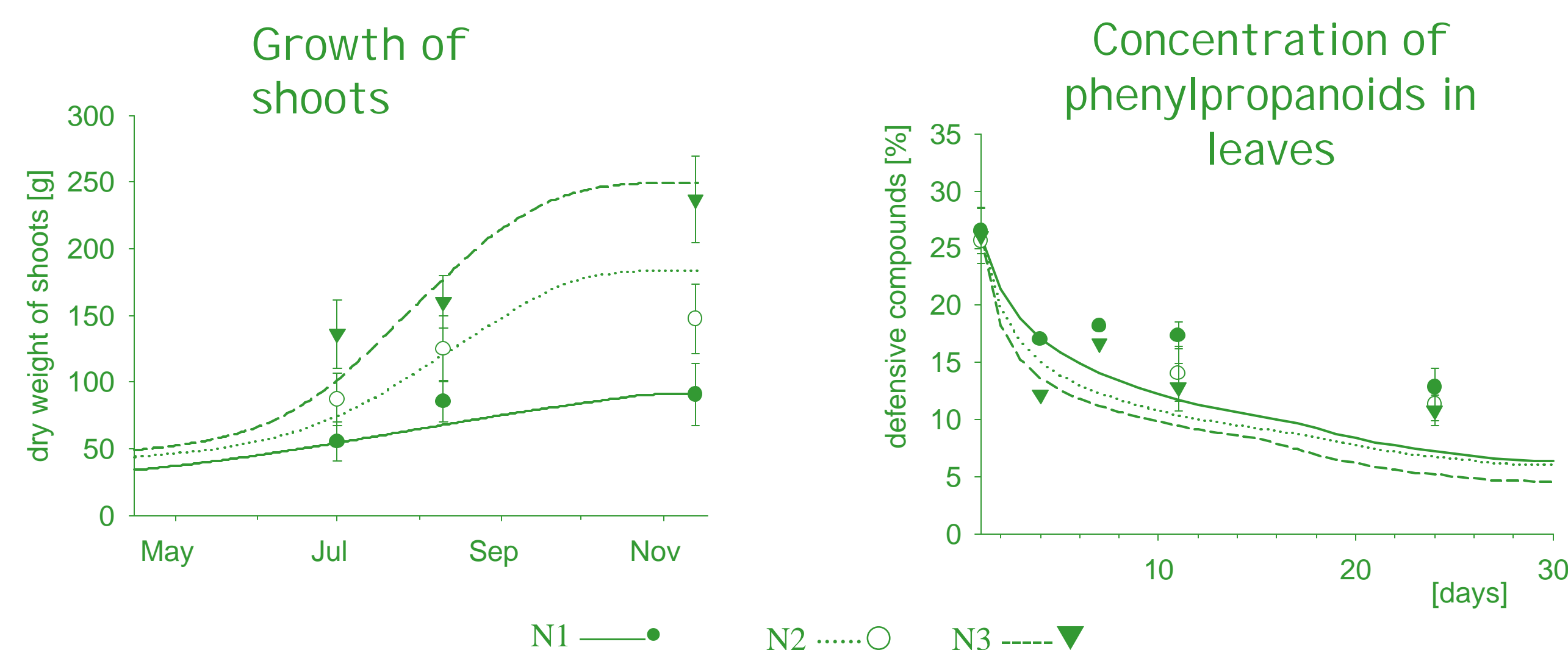


Plant morphology and interaction with neighbour individuals



Morphology of a plant is characterized by distribution functions for leaf area (a) and root length (b). Uptake capacity for external resources relates directly to actual biomass distribution. Inversely, the distribution of newly formed biomass relates to actual distribution of external resources.

Simulated (lines) and measured (symbols) effect of three nitrogen fertilisation levels on growth and formation of defensive compounds for young apple trees (data from A8):



Individuals can differ in start values of state variables as well as in ecophysiological parameters.

Competition between neighbouring plants i and j results from the intersection area of the zones that are influenced by the individuals.