

WeedML Sub-models

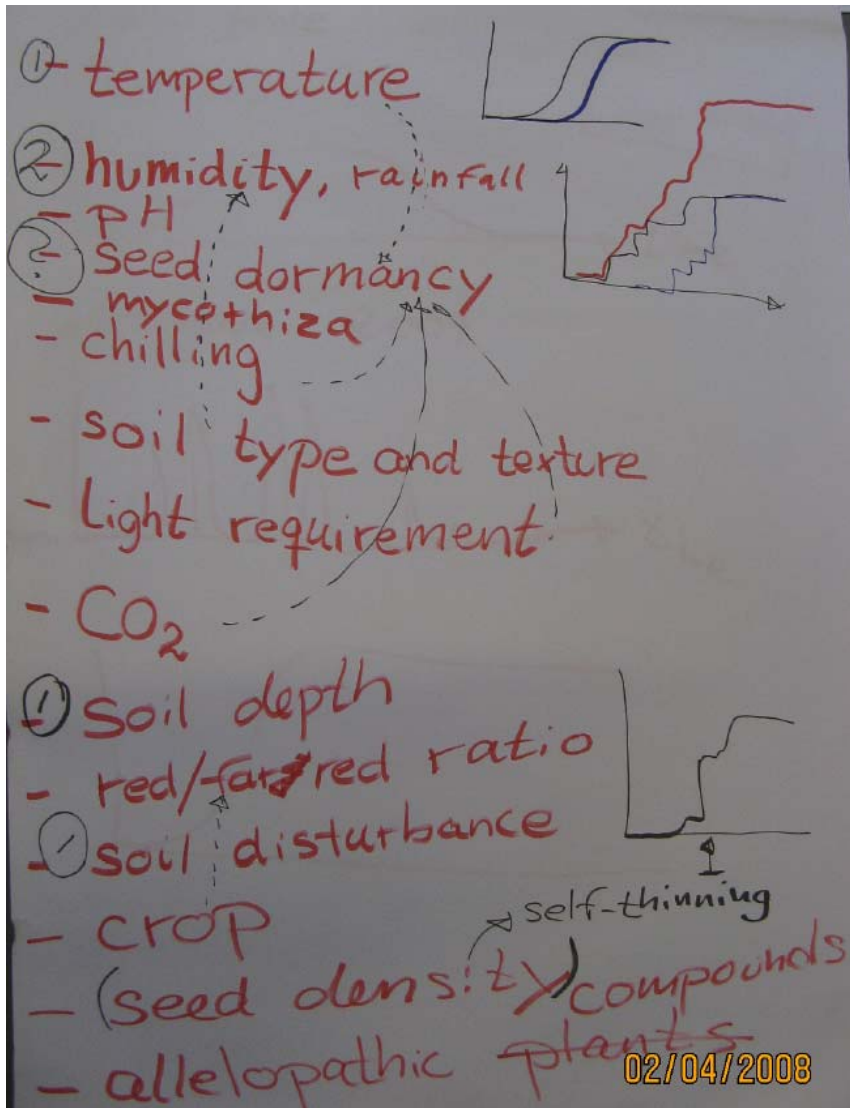
Version: 10 December 2008.

This documents is maintained to collect the ideas coming up during our workshops on how to model the various processes of weed population dynamics as separate sub-models.

The document can be found online at www.weedml.org/weedml/documents.html.

Germination and emergence

At the workshop in Budapest, December 2007, a brainstorm on the parameters important for weed germination and emergence resulted in this list:



Of these, temperature, soil depth and soil disturbance were given highest priority, humidity and rainfall second priority, while the rest remained unprioritized. Seed dormancy was given a question mark because it was found important but is itself a result of many of the other parameters.

Competition

Because there is such large variation around the Cousens curve, linking seedling density to percentage yield loss, it is important to model not only the average outcome but also the variation around that.

INTERCOM can be used to model crop-weed competition under different conditions and Cousens curve parameters (with uncertainty) can be estimate from such simulations.

Seedling cohorts must be considered to account correctly for weed reproduction and crop yield loss.

Late-comers may be more important than the first flush of seedlings, because late-comers even if they are few can produce many seeds since they are likely not controlled, whereas the first flush is easily controlled in herbicide-based agriculture.

Research questions to be addressed, especially through modelling

The questions below come in the order they were presented and discussed in Rothamsted, 24 November 2008.

1. WHAT ARE THE IMPORTANT PARAMETERS FOR COMPETITION?

A model can be used for sensitivity analysis. However, beware that this method will not identify important parameters that were left out of the model. Candidates for parameters, potentially important but left out for convenience, include weather, below-ground competition, fine roots dynamics, growth plasticity, spatial processes.

2. HOW COMPETITIVE ARE WEEDS THAT HAVE SOMEHOW BEEN WEAKENED?

Weed plants surviving a harsh winter or a control treatment might be marked not only by a delay in growth but by changes in physiology, that changes their basic biology.

Parameters that could be affected include relative growth rate, development rate, morphology.

3. WHAT IS THE COMBINED EFFECT OF CULTIVAR, SOWING DATE, SOWING DENSITY AND GEOMETRY, AND CONTROL TREATMENTS ON COMPETITION?

A model can be used to explore these multi-factor interactions and assess the contribution of each factor. However, one should be careful not to extrapolate unreasonably from the data on which the model was constructed or validated. It is also tempting to leave out potentially important factors because the model is already complex enough without them; see item 1 above.

4. ARE THERE MATERNAL EFFECTS ON PLANT COMPETITIVITY?

Such hypothetical effects could be expressed, e.g. in germination behaviour or early growth rate. Even a simple conceptual model (boxes and arrows) would help defining this question further and highlight the most probable effects to look for.

5. HOW IMPORTANT IS INTERSPECIFIC COMPETITION BETWEEN WEEDS, COMPARED TO CROP-WEED COMPETITION, IN DRIVING WEED COMMUNITY SUCCESSION?

Are some weeds rare because they are less competitive, more susceptible to control, less plastic? Are other biotic interactions important: diseases, herbivores? These questions are special cases of the more general item 1 above, and again a model could be used to sift through all these possible interactions and identify the possibly most important ones. Striking a neat balance between model simplicity and real-world complexity will be quite a challenge.

6. WHAT ARE THE EFFECTS OF CLIMATE CHANGE ON PLANT COMPETITION?

A model can be used to explore the effects of climate scenarios. This would demand a model that is weather- or climate-driven. A weather-driven model should be linked to a weather generator.