EXPLORATORY PROJECT

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Coordination
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Key words
Repeated thermal stress
Plant performance
Acclimatisation
Modelling
Data mining

INRAE units involved
EVA
AGAP Institut
ISPA

Partnerships
Lorraine Research Laboratory in
Computer Science and its Applications

Predicting the response of plants exposed to chronic thermal stress

Context and challenges

Climate change is characterised not only by variable and extreme intensities of the main climatic factors but also by an increased frequency of extreme events, such as heat waves, which are highly detrimental to field crop yields and harvest quality.

In this context, improving predictions of plant performances under repeated heat stress scenarii is a major challenge. The MIRRORS project is based on the hypothesis that the effect of a succession of stressful events is not equivalent to the sum of the individual effects of each event. Indeed, when plants have been exposed by an initial stress, their responses to subsequent stresses can be determined by this prior event as a consequence of a "memory effect" (which can be either penalising or beneficial).

In order to improve predictions of plant performance in repeated stress situations that are expected to occur more frequenlty, the MIRRORS project proposes methods and tools for generic predictions of the response of plants subjected to repeated thermal stress in particular.

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Metaprogramme
DIGIT-BIO

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Goals

We propose the following approaches, based on existing data sets for rapeseed and sorghum[1]:

1. Analyse the non-additive nature of the effects of heat stress events using complete datasets (climatic variables and plant performance criteria).
2. Identify agro-climatic indicators or specific thermal sequences related to the memory of heat stress. We will identify particular thermal scenarii, with recurrent patterns, and associate them with the observed plant performances (grain yield and seedquality criteria).
3. Then, two complementary approaches to modelling the effects of repeated thermal stresses will be developed, on both rapeseed and sorghum:
   - "concept-driven" based on the implementation of predictive ecophysiological models parameterised on these two species, in order to take these memory effects into account, and
   - "data-driven" guided by data mining methods with no mechanistic *a priori*.

Research units involved and partnerships

INRAE scientific division	INRAE research units	Expertises
Agronomy and environmental sciences for agroecosystems	EVA	Ecophysiology, agronomy, modelling
	AGAP Institut	Ecophysiology, statistical analysis and data mining
	ISPA	Ecophysiology, modelling, biogeochemistry
External partners		**Expertises**
Lorraine Research Laboratory in Computer Science and its Applications		Knowledge discovery, modelling

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[1] in the field and in the greenhouse