Will climate change affect sugar beet crop emergence of the 21st century? Insight from a simulation study

Jay Ram Lamichhane, Julie Constantin, Jean-Noël Aubertot, Carolyne Durr

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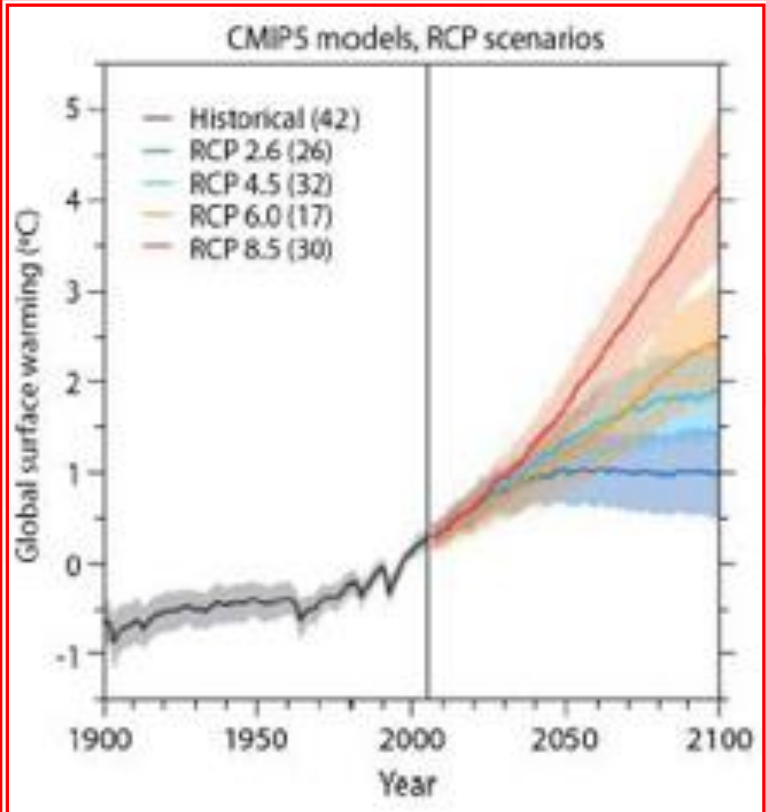
INRA SCIENCE & IMPACT



Daily predicted variables at a local scale

Air temperatures, rainfalls, wind, global radiation,….

1

STICS: a generic model for the simulation of crops and their water and nitrogen balances. I. Theory and parameterization applied to wheat and corn

Nadine Brisson [a*], Bruno Mary [a], Dominique Ripoche [a], Marie Hélène Jeuffroy [a], Françoise Ruget [a], Bernard Nicoullaud [a], Philippe Gate [b], Florence Devienne-Barret [a], Rodrigo Antonioletti [a], Carolyne Durr [a], Guy Richard [a], Nicolas Beaudoin [a], Sylvie Recous [a], Xavier Tayot [c], Daniel Plenet [a], Pierre Cellier [a], Jean-Marie Machet [a], Jean Marc Meynard [a], Richard Delécolle [a]

[a] Département environnement et agronomie, Inra, site Agroparc, 84914 Avignon cedex 9, France
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(Received 13 March 1998; accepted 9 July 1998)

Predicted variables

Seedbed temperature

Seedbed water content

2

SIMPLE: A Model for SIMulation of PLant Emergence Predicting the Effects of Soil Tillage and Sowing Operations

C. Dürr,* J.-N. Aubertot, G. Richard, P. Dubrulle, Y. Duval, and J. Boiffin

Reprinted from the *Soil Science Society of America Journal*
Volume 65, no. 2, Mar.–April 2001
677 South Segoe Rd., Madison, WI 53711 USA

3

Predicted variables

% germination

% emergence,

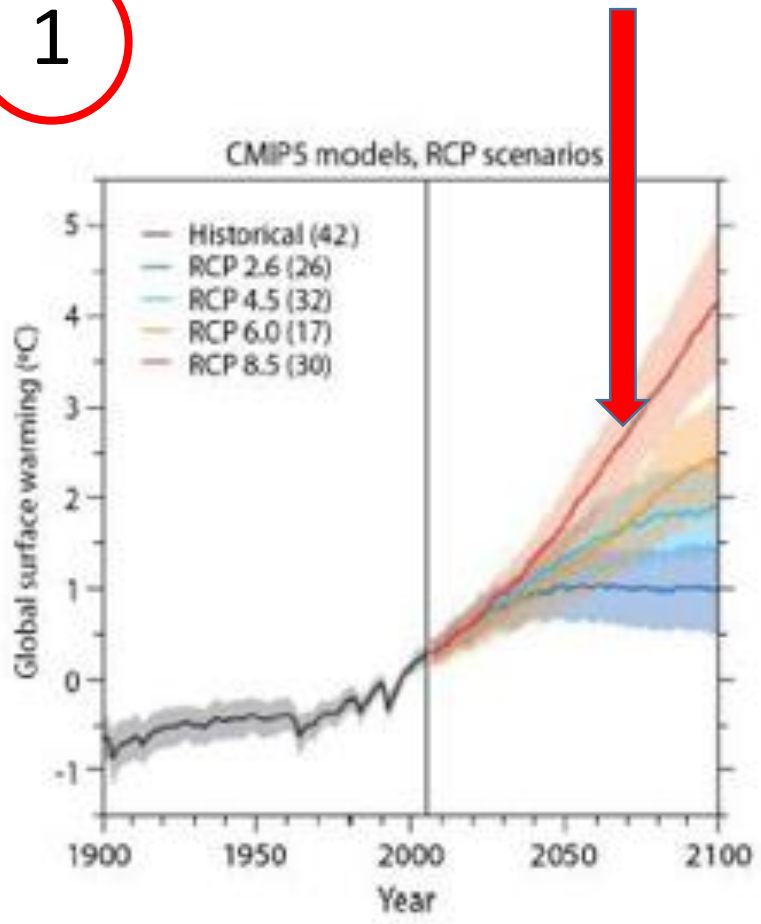
Time to Germ-Emer

Causes of non emergence

% of bolting

Regionalized scenarios of climate change

1



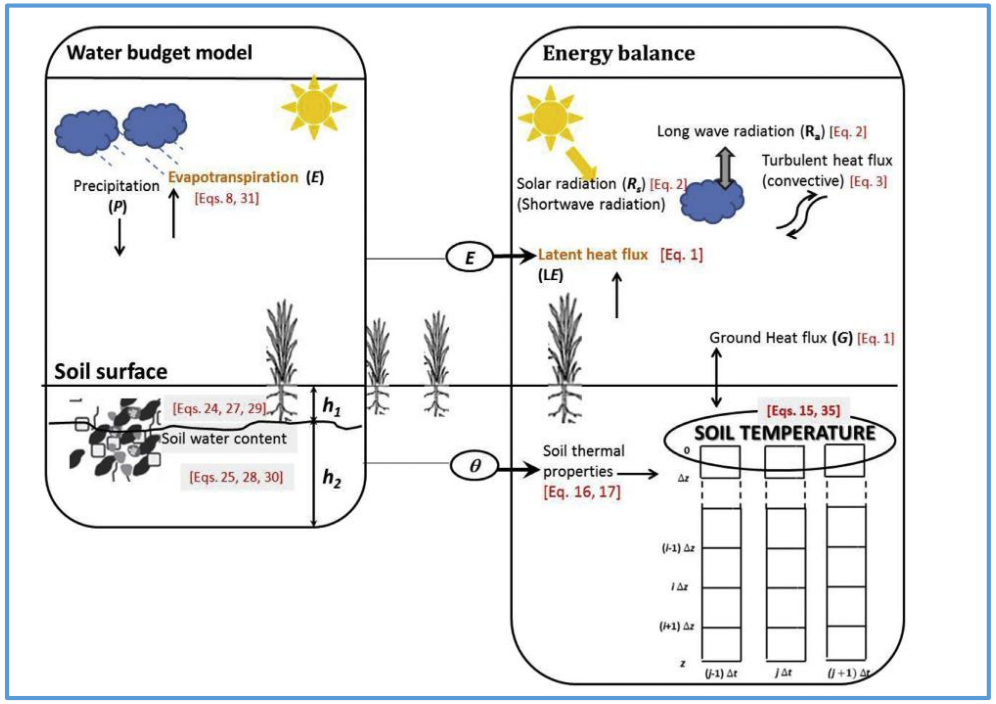
Northern France
Air temperatures
wind, global radiation
Rainfalls

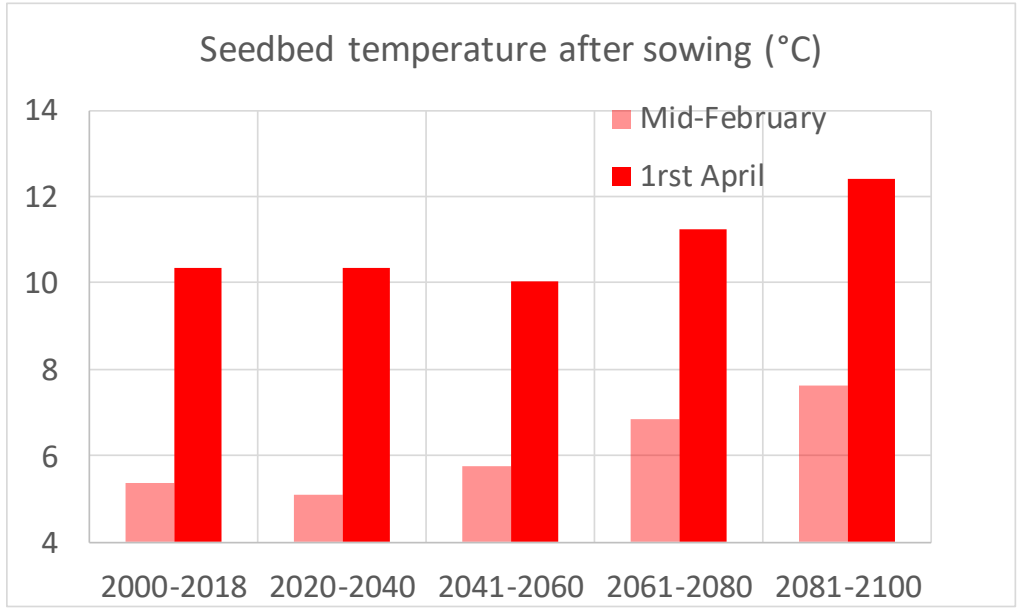
2020 - 2100

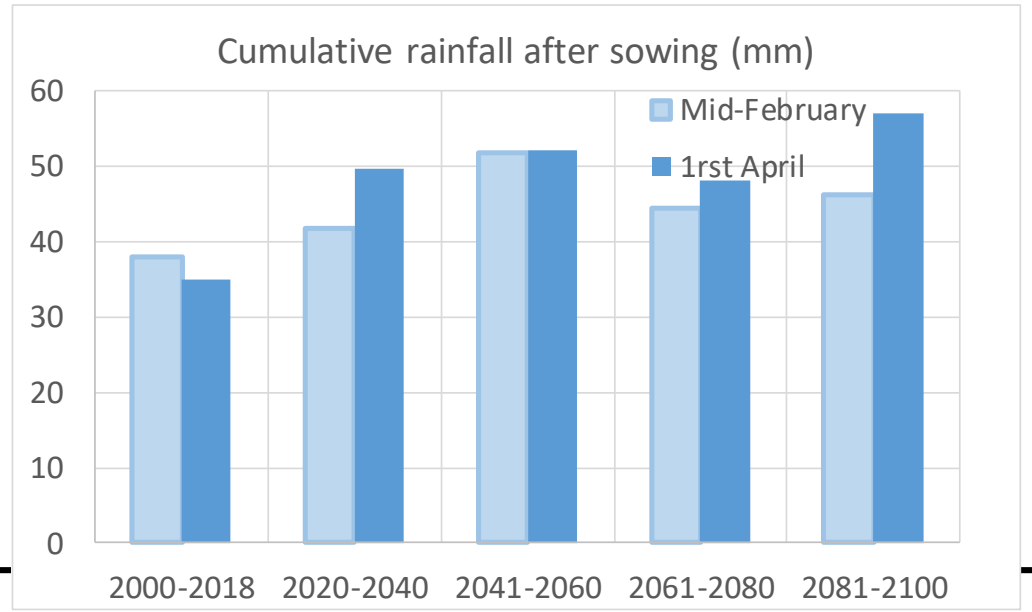
Sugar beet cropping area in France

Simulated seedbed climate

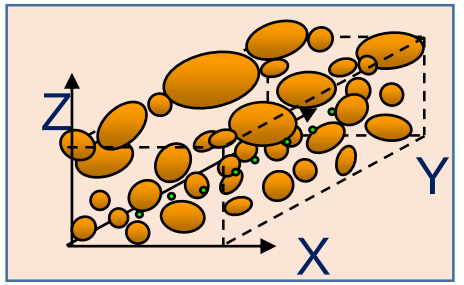
2 STICS







The SIMPLE model's main principles



3

Input variables

Soil structure
= f (tillage and sowing operations)

Species and seed lot characteristics

Climate and soil characteristics

3D seedbed generator

Equations for prediction of Germination and seedling growth

T°, H_2O, soil surface crusting

Output variables

Germination times and rates

Emergence times and rates

Seedling's early growth

Simulation of sugar beet establishment

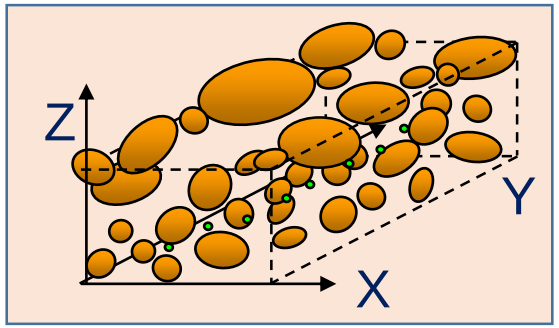
5 sowing dates

- Mid-February
- 1st March
- **Mid-March**
- 1st April
- Mid-April

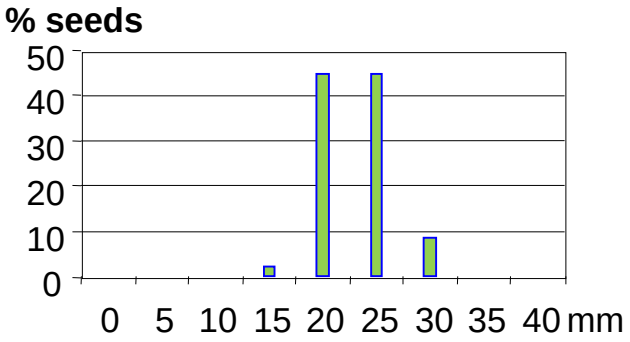
2020 -2100

- Seedbed temperatures
- Seedbed water content
- Daily rainfalls
- Air temperatures

Seedbed structure



Sowing depths



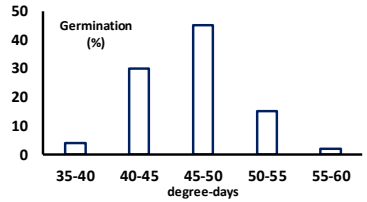
Total : 405 simulations

(405 000 individual seeds)

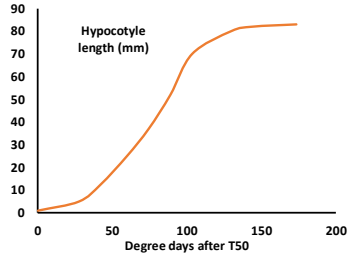
Sugar beet parameter values

Tb 3.5°C; ψb 1. 96 MPa

Germination speed

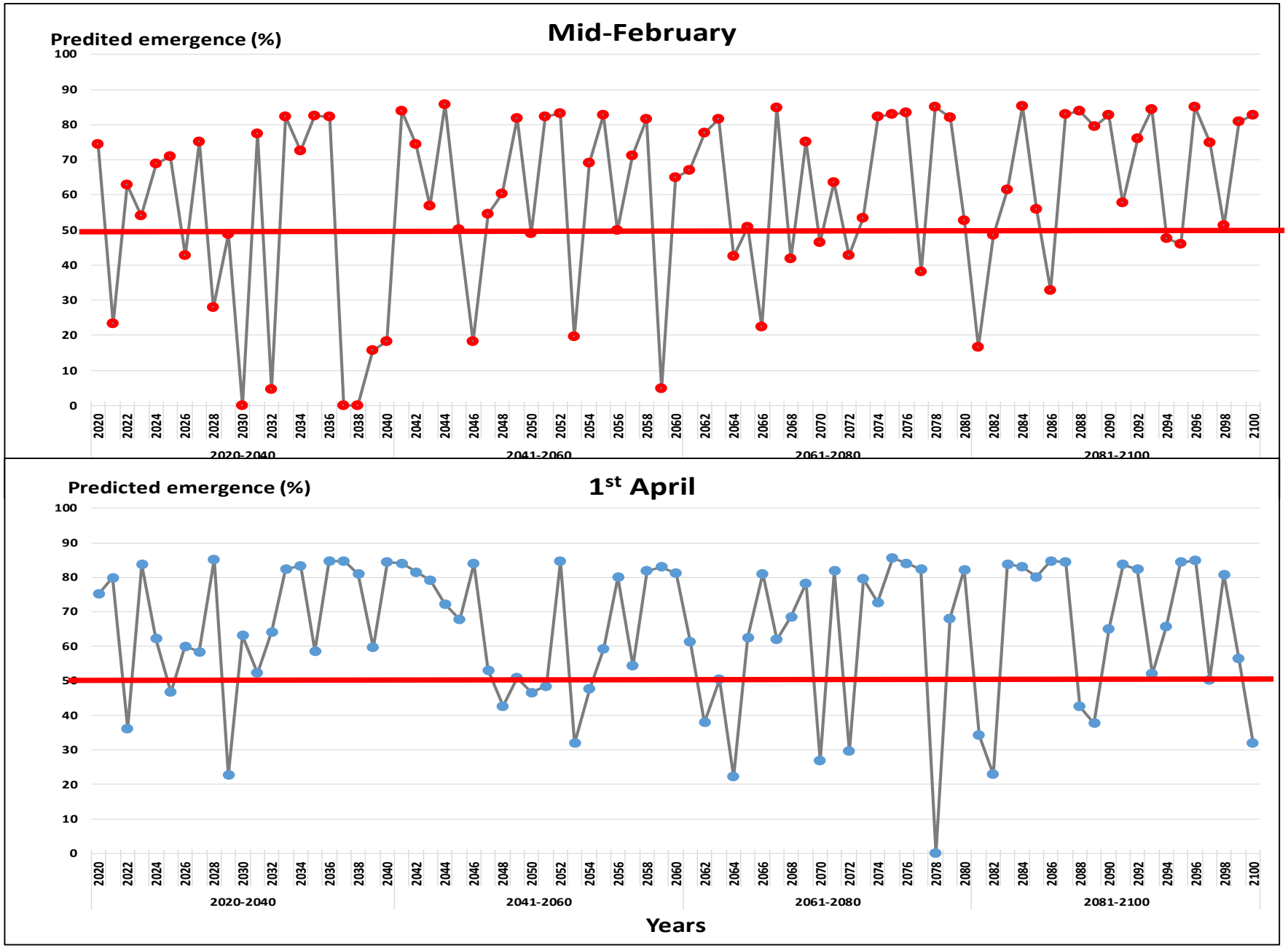


Radicle and hypocotyl elongation



Clods and crust sensitivity

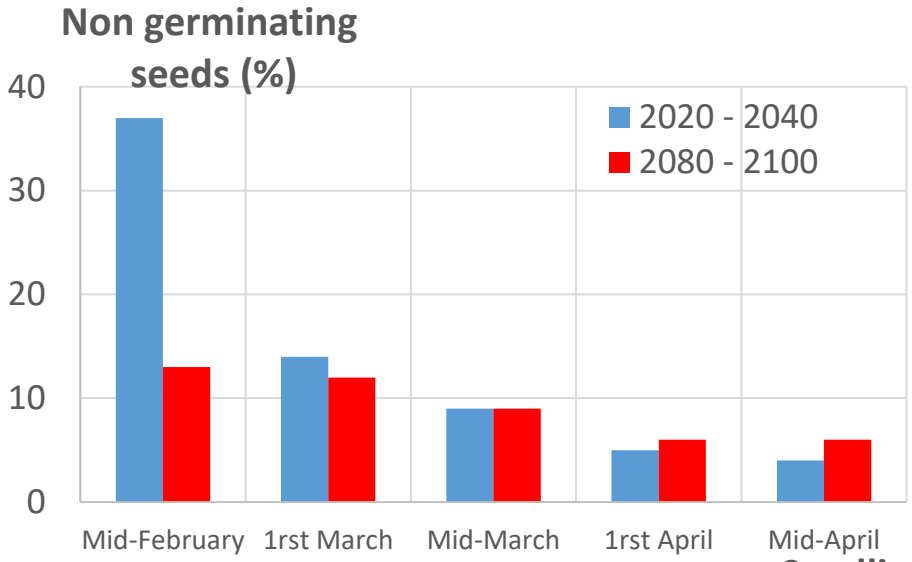
Results

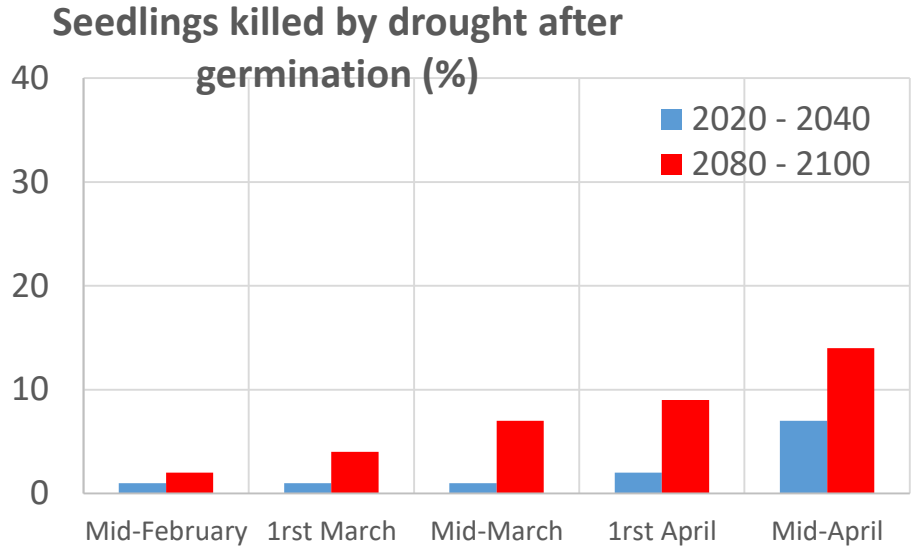


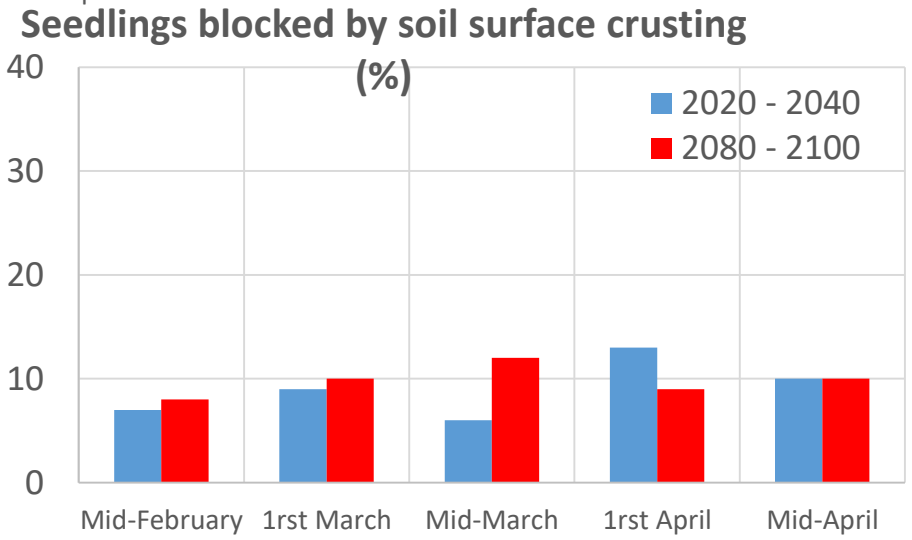
	2020 -2040	2080 -2100
Emergence rate %	48 ± 32	68 ± 20
Nb days to max emergence	45 ± 24	37 ± 10

	2020 -2040	2080 -2100
Emergence rate %	69 ± 15	74 ± 15
Nb days to max emergence	28 ± 7	23 ± 8

Causes of non emergence

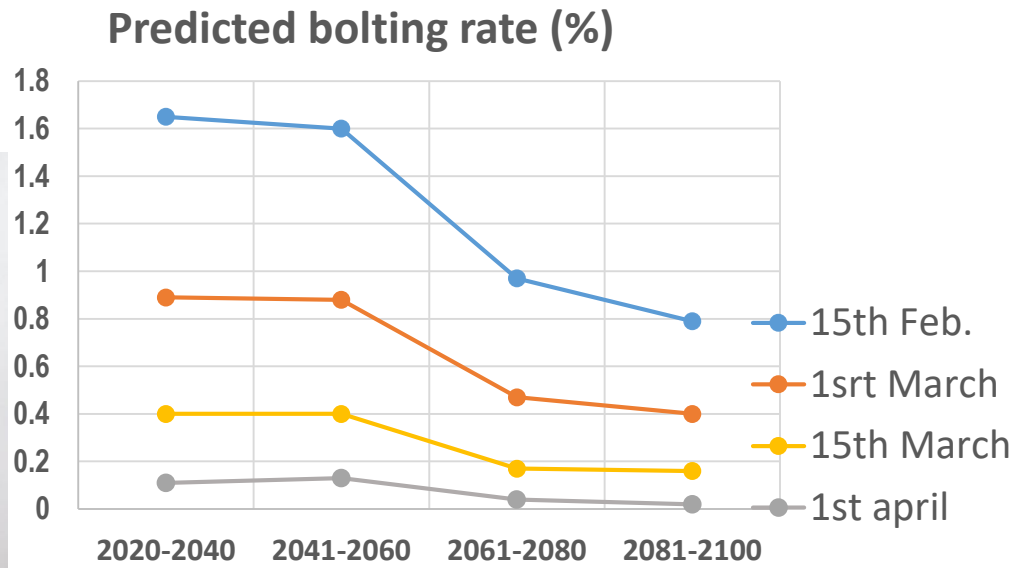


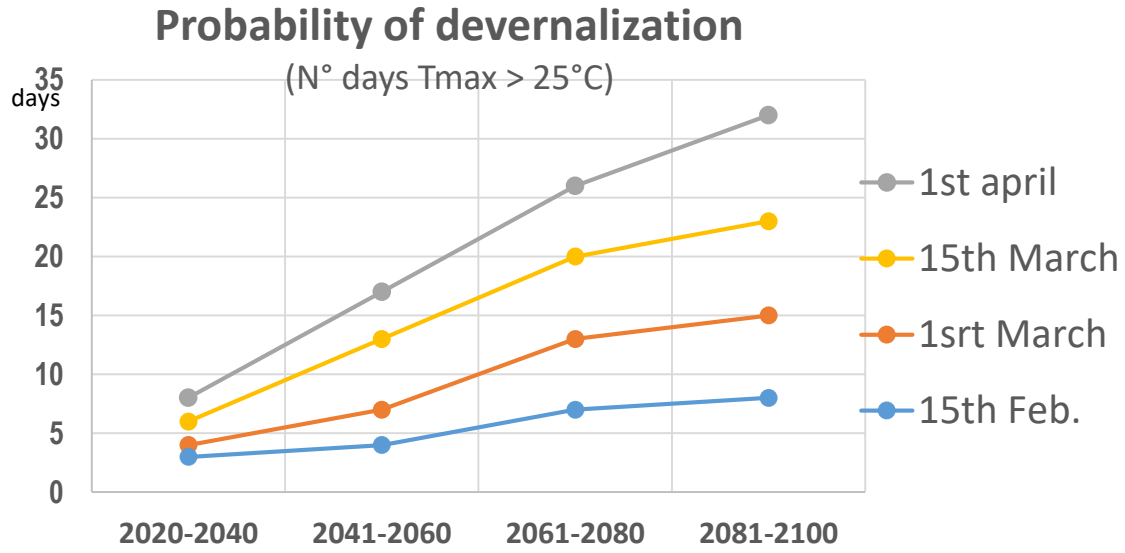




Bolting risks

Source image IRBAB



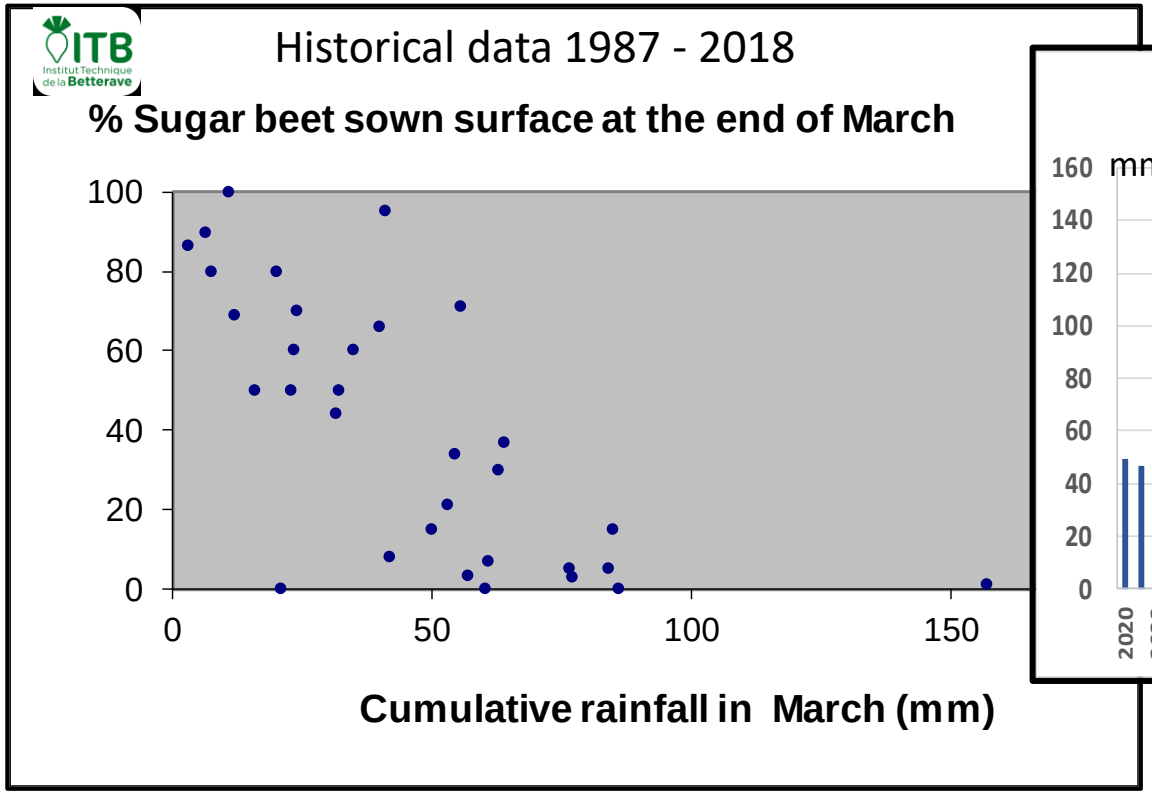


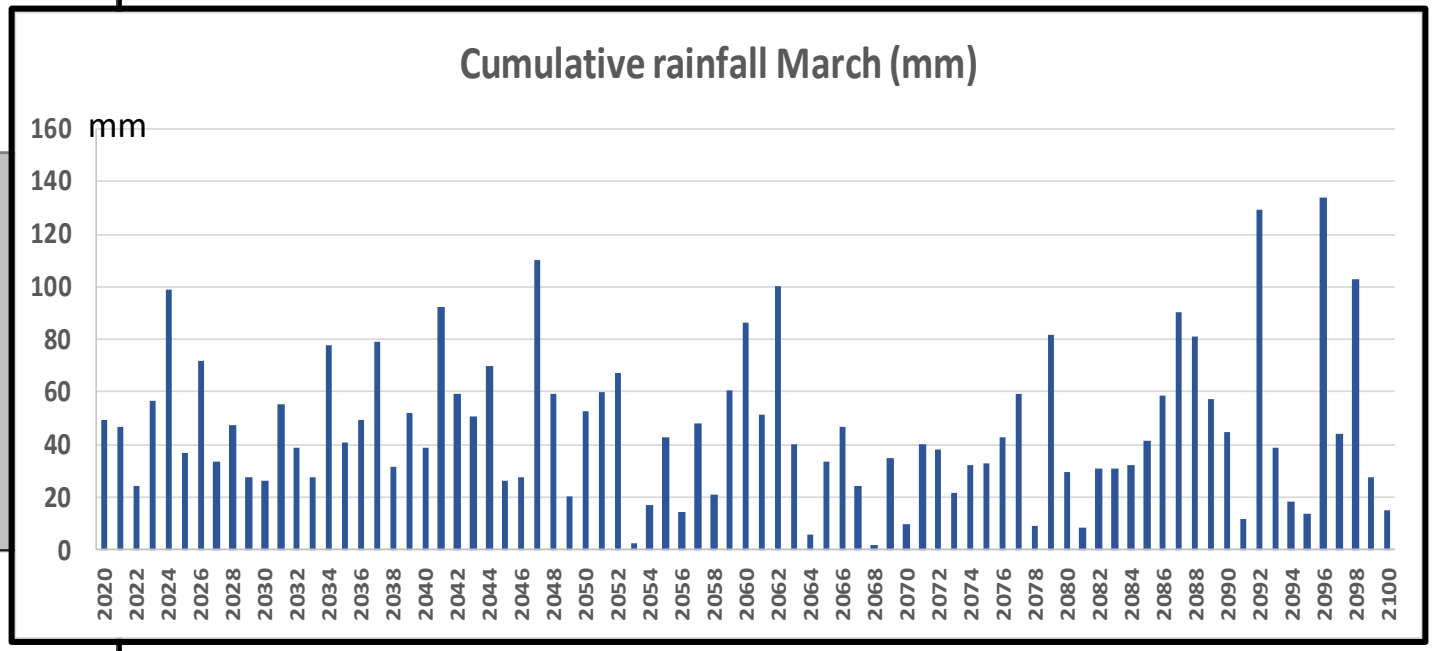
Bolting rate = f(T < 12°C after sowing;
and Tmax > 25°C 60-120 days after sowing over 7 days)

Longden et al, 1975; Fauchère et al, 2003

Field access during the sowing period

Historical data 1987 - 2018





Predicted cumulative rainfalls 2020 - 2100

Conclusions

An insight into the future has been possible with the help of

- Precise geolocalized climatic scenario
- Detailed crop models for simulation

Main results

- Main changes will occur **after 2060**
- An **increase in temperatures** will favor **crop establishment** and **decrease bolting risk**
- **Rainfalls will be a** main limit **preventing field access**

Limits

- Quality of models and hypothesis
- Biotic stresses

Acknowledgements

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Thank you for your attention