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"Towards shifting paradigms in agriculture for a healthy and sustainable future"

UNIVERSITY OF HOHENHEIM

Coping with Erratic Rainfall: A Model Approach for Improving Maize Sowing Date

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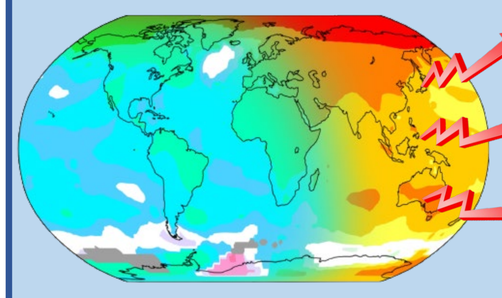
Food Security Center

Introduction



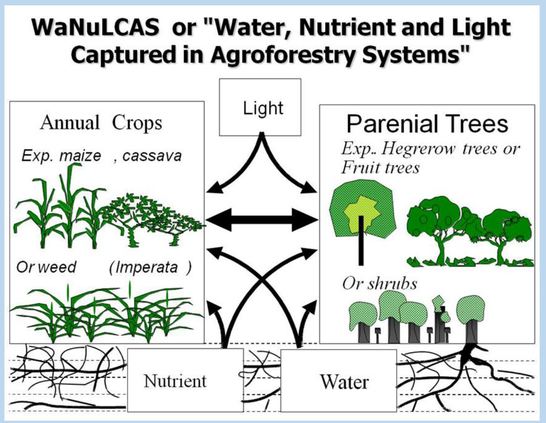
Rainfall variability
Temperature variability
Frequent extreme weather

Climate change

Maize production

- Drought and heat stress
- Low maize yield
- Management changes
- Worldwide food insecurity

Modelling approach



Objectives of this study

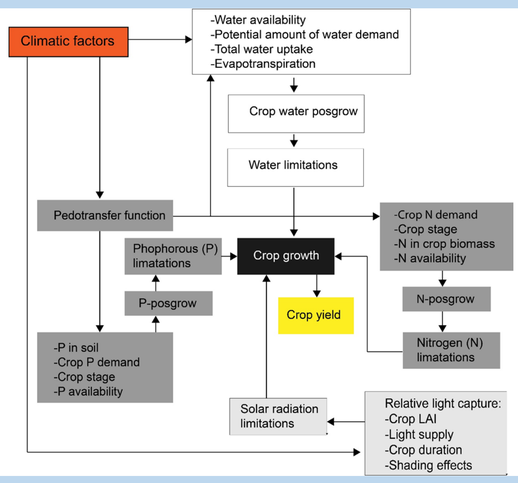
(i) evaluating the ability of the Water, Nutrient and Light Capture in Agroforestry Systems (WaNuLCAS) model for predicting maize performance under rainfed conditions,
(ii) assessing the performance of maize under various sowing date options to sustain maize yields, and
(iii) identifying the best sowing option under irregular rainfall.

Materials and Methods

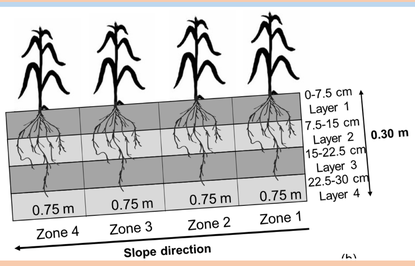
1. Location and data collection

- The experiment was conducted at Phitsanulok province, Thailand (16°54'21.6"N 100°32'31.2"E)
- Two years of maize (*Syngenta 6248*) data, soil parameters and weather conditions (2017 and 2018) were collected.
- Historical (50 yrs) weather data of Phitsanulok province received from Thai Meteorological Department were used to investigate the effects of rainfall variability on maize yields.

2. WaNuLCAS structure and input data



Structure of the WaNuLCAS crop module: Crop growth and yield, influencing parameters and indicators for growth limitations



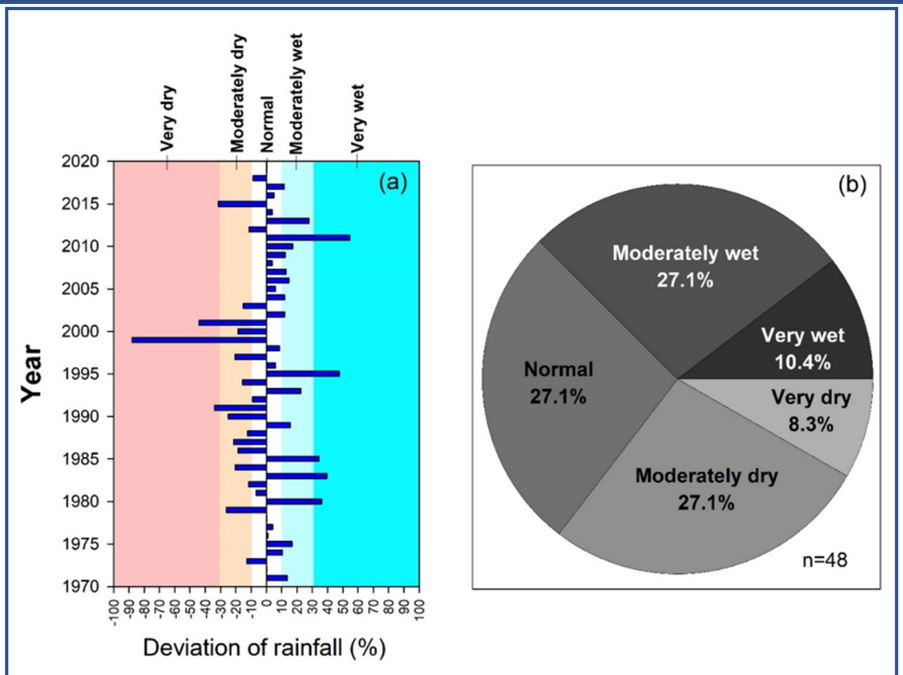
WaNuLCAS setup: Zone and layer settings represent row width and soil depth of the field experiment

3. Treatment description and scenarios

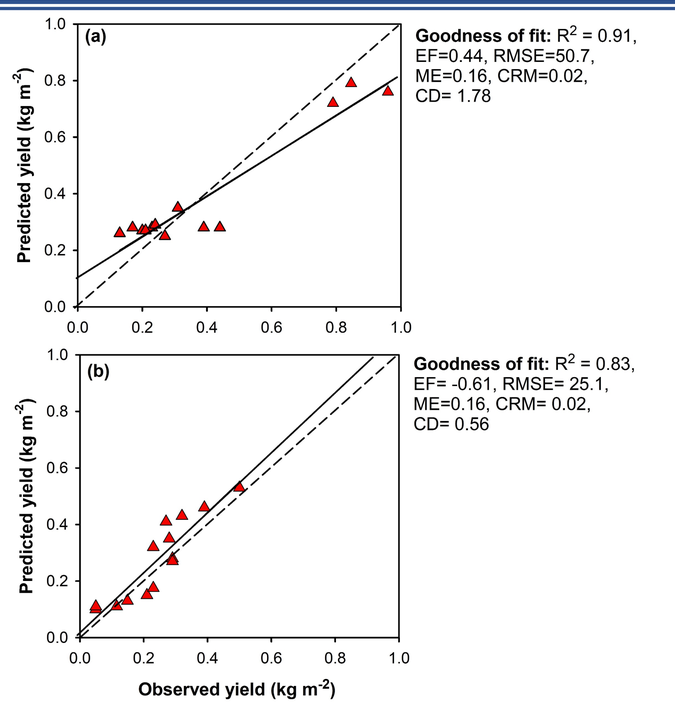
Scenarios used for simulating impact of sowing dates on maize grain yield with WaNuLCAS

Scenarios (S)	Description
S1 - Farmers' practice (FP, control)	Maize sowing mid-July equal to Julian day 195
S2 - 15 days before FP	Maize sowing early July equal to Julian day 180
S3 - 30 days before FP	Maize sowing mid-June equal to Julian day165
S4 - 45 days before FP	Maize s sown early June equal to Julian day 150
S5 - Staggered planting	Maize sowing differed in each zone; timing according to sowing dates of S1-S4
S6 - Rainfall predictions for 21st Century	Maize growing was simulated using rainfall projections of the northern region of Thailand for the 21st century (Tangang et al., 2019)

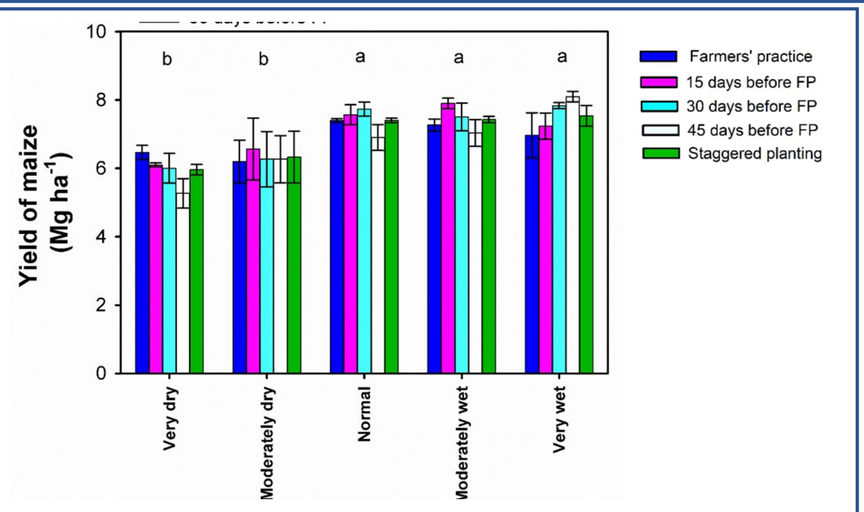
Results



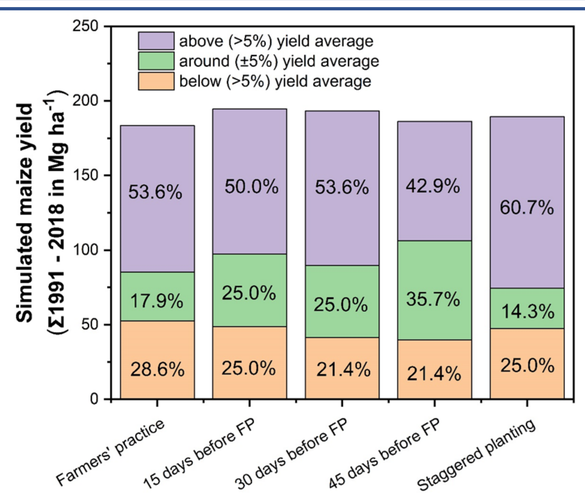
Long-term annual rainfall variation (1971-2018; 1380 mm) of the Phitsanulok province, Thailand (a) and probability of five rainfall categories (b): Rainfall data were provided by the Meteorological Department of Thailand:



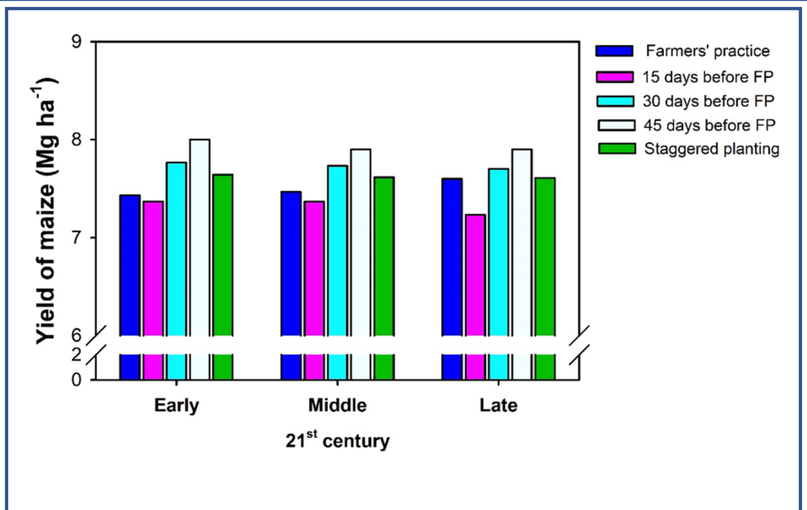
Relationship between predicted and observed maize grain yield: (a) calibration, (b) validation. Data were collected during 2017 (validation) and 2018 (calibration) at Wang Thong district, Phitsanulok province, Thailand



Simulated maize grain yield as affected by four sowing dates (Farmers practice (FP, = Mid of July) and 45, 30,15 days before FP), staggered planting (based on all sowing dates) and five rainfall categories for the Phitsanulok province, Thailand



Simulated cumulative maize grain yield as affected by sowing date (Farmers' practice (FP, = Mid of July) and 45, 30,15 days before FP), staggered planting (based on all sowing dates) using historic rainfall data of the Phitsanulok province, Thailand. Yield of maize is categorised intro three groups: above (>5%), around (±5%) and below (>5%) average yield



Impact of rainfall projections for the 21st century and sowing date on maize yield. Rainfall projections for the Phitsanulok of Thailand are based on Tangang et al., (2019)

Conclusion

(i) The WaNuLCAS model was able to predict maize yield well (Goodness-of-fit statistics: R^2=0.83; EF=-0.61; ME=0.16; CRM=0.02; CD=0.56)
(ii) Sowing maize 30 days before farmer's practice or staggered planting are suitable options for areas with irregular rainfall conditions, the later particularly when distinct weather forecasts are not possible. Both options reduced the risk of crop failure while maintaining yields under these conditions.