Calibration and Evaluation of the STICS Intercrop Model for Two Cereal-Legume Mixtures
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To cite this version:
Kirsten Paff, Sebastian Munz, Rémi Vezy, Noémie Gaudio, Laurent Bedoussac, et al.. Calibration and Evaluation of the STICS Intercrop Model for Two Cereal-Legume Mixtures. 2. International Crop Modelling Symposium (iCROPM2020), Feb 2020, Montpellier, France. 1 p., 2020. hal-02791381

HAL Id: hal-02791381
https://hal.inrae.fr/hal-02791381
Submitted on 5 Jun 2020

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The aim of this study was to calibrate and evaluate the STICS Intercrop model for two cereal-legume mixtures (winter and spring intercrops) simulating two types of cereal-legume mixtures (winter crops could reduce inputs and potential environmental damage through N losses and spring intercrops) to determine the validity domain.

The species and cultivar parameters calibrated in step 1 are used again for intercrop simulations in step 2.

### Materials and Methods

- French data sets comprised of 4 years of winter wheat (*Triticum turgidum* L.) and pea (*Pisum sativum* L.) (Bedoussac, 2009; Kammoun, 2015), and 4 years of spring barley (*Hordeum vulgare* L.) and pea (Corre-Hellou, 2005) including different N levels and plant densities (Table 1)
- 3-step Approach: 1) Calibration of species and cultivar parameters with sole crop data; 2) Calibration of two intercrops parameters; 3) Evaluation for intercrop data, in order to determine the validity domain.
- Step 1 of calibration followed the order: phenology, leaf area, biomass, nitrogen uptake/fixation, and grain yield
- The species and cultivar parameters calibrated in step 1 are used again for intercrop simulations in step 2

### Results and Discussion

#### Sole Crops

- Largest source of error was winter pea (nRMSE=40.0 %)
- All other crops had a nRMSE<17.0 %
- Simulated winter pea reached max LAI too early, possibly a result of limited observed phenology data → further research needed

#### Intercrops

- Largest source of error was winter pea (nRMSE=80.9 %)
- High nRMSE for all other crops (37.4 to 60.3 %)
- Winter wheat crop height increased too quickly in simulations, causing overestimation of biomass and grain yield → further revision of height simulation formals needed to avoid bias

### Conclusion

- Based on the sole crop calibration, some intercrop situations could be correctly simulated
- Further analysis of the model’s simulation of interspecific competition is necessary to better capture the large variation in observed data and to improve model accuracy
- With these future improvements, the STICS intercrop model can be a useful tool for better understanding the biological functions of intercropping systems to and assist in optimizing their management

### Table 1: Description of the observed field data.

<table>
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<tr>
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<th>Winter Wheat</th>
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<th>Spring Barley</th>
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</tbody>
</table>

### Figures

- **Figure 1**: Comparison of simulated observed grain yield for sole crop winter wheat, winter pea, spring barley, and spring pea.
- **Figure 2**: Comparison of simulated observed partial land equivalent ratio (LER) for intercropped winter wheat/winter pea and spring barley/spring pea.

### Sources

- Vezy R et al. (2020) Implementation of new formalisms in STICS for intercropping modeling, iCROPM, Montpellier, France.