



HAL
open science

Calibration and Evaluation of the STICS Intercrop Model for Two Cereal-Legume Mixtures

Kirsten Paff, Sebastian Munz, Rémi Vezy, Noémie Gaudio, Laurent Bedoussac, Eric Justes

► **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 (iCROP2020), Feb 2020, Montpellier, France. , 1 p., 2020. hal-02791381

HAL Id: hal-02791381

<https://hal.inrae.fr/hal-02791381>

Submitted on 5 Jun 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Calibration and Evaluation of the STICS Intercrop Model for Two Cereal-Legume Mixtures

Paff, Kirsten^{1,2}, Munz Sebastian³, Vezy Rémi⁴, Gaudio Noémie⁵, Bedoussac Laurent⁵, Justes Éric^{2,6}

¹INRA, UMR SYSTEM, F-34398 Montpellier, France, email: kirsten.paff@inra.fr

²SYSTEM, Univ Montpellier, CIRAD, INRA, IRD, Montpellier SupAgro, Montpellier, France

³Institute of Crop Science, University of Hohenheim, 70599 Stuttgart, Germany

⁴CIRAD, UMR AMAP, F-34398 Montpellier, France

⁵INRA, UMR AGIR, 31326 Castanet-Tolosan, France

⁶CIRAD, PERSYST Department, 34398 Montpellier, France

Background

- Intercropping, i.e. multiple species grown simultaneously on the same field, used as a way of ecological intensification
- Especially mixtures of leguminous and non-leguminous crops could reduce inputs and potential environmental damage through N losses
- Intercropping increases system complexity
- The aim of this study was to calibrate and evaluate the improved STICS-Intercrop model (Vezy et al., 2020) by simulating two types of cereal-legume mixtures (winter and spring intercrops)

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

Table 1: Description of the observed field data.

	Winter Wheat	Winter Pea	Spring Barley	Spring Pea
Location	Auzeville, France	Auzeville, France	Angers, France	Angers, France
Years	4	4	4	4
N Levels	4	2	2	2
Densities	2	2	2	2

Results and Discussion

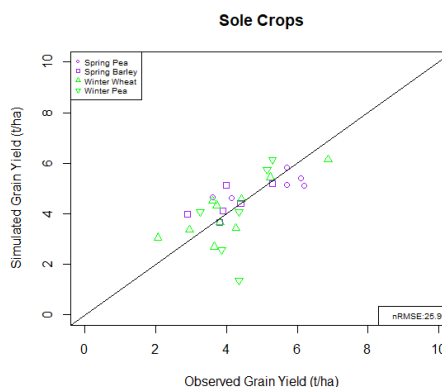


Figure 1: Comparison of simulated observed grain yield for sole crop winter wheat, winter pea, spring barley, and spring pea.

- 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

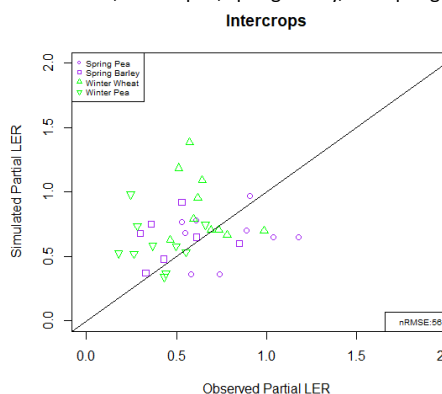


Figure 2: Comparison of simulated and observed partial land equivalent ratio (LER) for intercropped winter wheat/winter pea and spring barley/spring pea.

- 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 formalisms 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