A Simple Approach for the Estimation of Crop Interception Values for Leaf Development Stages

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INTRODUCTION

A literature review was carried out in 2010 on behalf of EFSA to collect data for spray plant interceptions, as the values established by FOCUS in 2000 were only based on a limited experimental dataset. Out of a total of 55 relevant references, not more than 20 were available for a few arable crops. Data for leaf developmental stages (BBCH 10-19) was even more limited. Surprisingly, there were even negative interception values in a few cases. In total, the EFSA literature review showed that reliable data is not publicly available in an appropriate amount. Thus, we tested a simple approach that allows an estimation of the interception values for early crop development stages of annuals crops.

MATERIAL & METHODS

We determined the soil cover by taking digital photographs for several crops (wheat, maize and oilseed rape) at early growth stages. Photographs were taken directly above the crop. Afterwards, the proportion of the green parts of the photograph was determined with a pixel color based algorithm to estimate the ground cover of the crops. Since a digital photograph represents a two dimensional area, we assume that the ground cover represents a conservative estimation for the interception values.

In addition, the LAI values were occasionally measured by a destructive method, representing the three dimensional area, which represents the maximum interception potential of a crop. For comparison we calculated interception values for winter wheat with a simple exponential model based on LAI (Gyldenkaerne et. al. 1999[1]). LAI input values were calculated with a crop development model (Ratjen 2012[2]) using climate data from Northern Germany measured in 2013/2014.

RESULTS

Figure 1: Winter oilseed rape at different BBCH stages (from left to right: 12, 13-14, 14-15, 16). The second picture shows an example for detecting the soil background (non-green parts) of the picture of our tool. The suggested interception value by EFSA[3] is 40% for all of these leaf development stages of winter oilseed rape. Our analysis showed values between 4 and 86% (see Table 1 below).
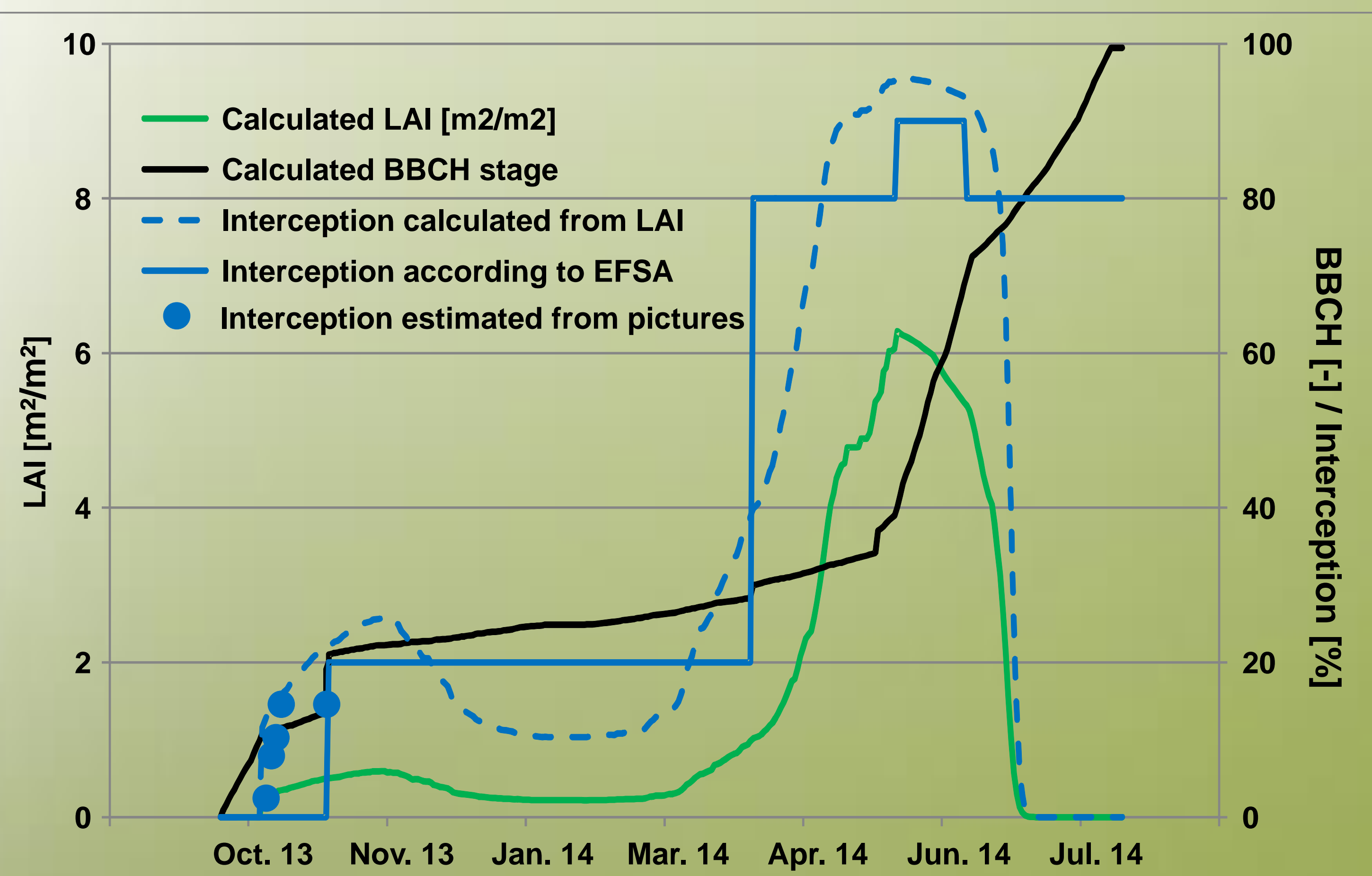

Figure 1: Winter wheat interception values estimated from photographs (blue circles) in comparison to estimated values based on LAI model outputs (blue dotted line) and interception values from EFSA[3] (solid blue line). The difference (EFSA vs. LAI) varied between -20% to +40%.

Table 1: Soil cover values for winter oilseed rape, winter cereals and maize estimated from photographs in comparison to destructive measured LAI values and interception values from EFSA[3]

Crop	BBCH [-]	Soil Cover [%]	LAI [m²/m²]	EFSA [%]
WOSR	12	4	0.03	
	12-13	5	0.07	
	13-14	19	0.19	40
	14-15	41	0.52	
	15	49	-	
	16	86	-	
Winter Cereals	10	2	0.07	
	11	8	0.09	
	12	11	0.12	0
	13	16	-	
	19	15	-	
Maize	12	2	0.04	
	13	4	0.07	
	14	8	0.14	25
	15	9	0.16	
	16	19	0.36	
	16-18	39	0.31	

CONCLUSION

The current EFSA values are only rough estimates, which over- as well as underestimate the crop soil cover. Results showed that our simple tool can be used to estimate conservative interception values for leaf development stages. We recommend to estimate the interception values for all annual crops implemented in FOCUS models by using our approach.

REFERENCES

[1] Gyldenkaerne, S., Secher, B. J. M.,Nordbo, E., 1999. Ground deposit of pesticides in relation to the cereal canopy density. Pesticide Science 55: 1210 – 1216

[2] EFSA, 2014. EFSA Guidance Document for evaluating laboratory and field dissipation studies to obtain DegT50 values of active substances of plant protection products and transformation products of these active substances in soil. EFSA Journal2014;12(5):3662,37pp.

[3] Ratjen, A.M. 2012. Refined N-Fertilization of winter wheat: A model supported approach combining statistical and mechanistic components, Ph.D. thesis, Kiel University, Germany.