UNIVERSITÄT HOHENHEIM

Institute of Plant Production and Agroecology in the Tropics and Subtropics

Parameterization and calibration of an empirical crop model for North Thailand

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Introduction

In order to assess and predict land use change in Mae Sa watershed, North Thailand, a Land Use Change Impact Assessment (LUCIA) model is generated, which includes the Tropical Soil Fertility Calculator (TSPC) as a crop module. TSPC has low data requirements and is based on empirical yield functions accounting for N, P, K and water as yield determinants.

The objectives of this study were to establish functional relationships between yield and fertilizer use for three crops, sweet pepper (*Capsicum annuum)*, cabbage (*Brassica oleracea)* and litchi (*Litchi chinensis),* and adapt water stress functions to the TSPC.

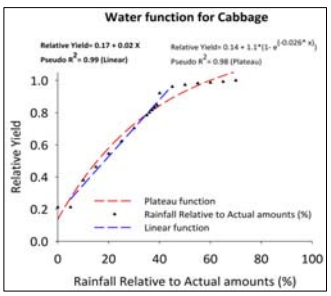
Materials and Methods

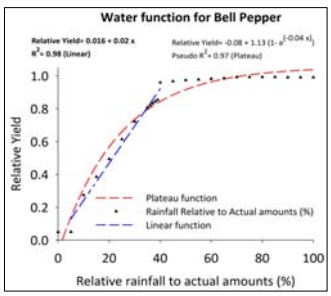
Data from literature review were used to estimate yield response functions to different fertilization rates for every crop and nutrient. Per study and per nutrient two response functions (exponential rise to maximum and Gaussian) were used to fit nutrient levels to yield data by using non-linear procedures.

Water supply was taken up into the TSPC as an additional constraint to crop production. Linear and plateau water stress transfer functions obtained from CROPWAT model runs were integrated to estimate site-specific crop water requirements.

Results

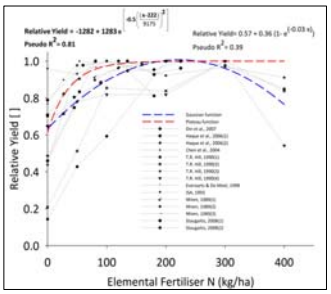
Water Response



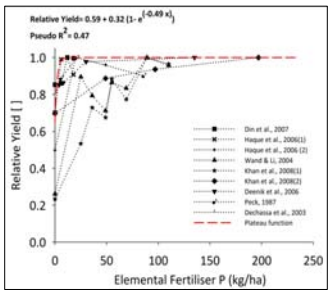


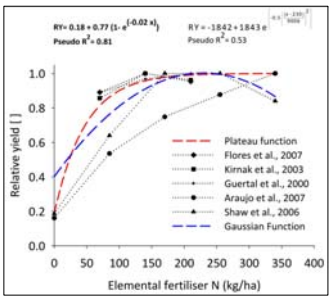
Plateau and linear functions (the latter with cut-off at optimum yield) were combined to fit yield response to water supply.

Crop Nutrients

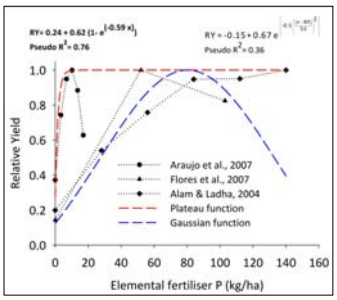


Cabagge





Bell Pepper



Yield response to Potassium application presented a behavior similar to that to Phosphorus fertilization.

The yield response to different fertilization rates of N, P and K follows the law of diminishing returns, each added fertilizer increment producing a progressively smaller yield increase, finally reaching an asymptote. Only for N fertilization in cabbage the Gaussian function gave a clearly better statistic fit (Pseudo R^2 = 0.81).

Discussion

Yield response functions to nutrients and water usually showed the best statistical fit when the plateau function was used.

This function makes sense when oversupply does not occur as is the case for P and K within the given ranges. Excessive doses of N, however, can lead to a shift in vegetative:generative growth rates or increase of pest pressure, which may reduce yields.

Yield reduction due to excessive water supply is not considered likely under the given climate and mostly well-drained soils of Mae Sa. At similar statistical fit, a linear equation with cut-off at optimum yield is preferred, because it allows to parametrise the model from a minimum of two cardinal points.

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