# Irrigation need and expected future water availability for potato production in Belgium

**Pieter Janssens, Frank Elsen, Wendy Odeurs, Tom Coussement, Jan Bries, Hilde Vandendriessche**

## Introduction

Potato production in Belgium covers approximately 5 % of the total arable land. Although Belgium is situated in the temperate climate zone, dry periods can occur during summer. Trials on Belgian potato fields indicate a tuber yield decline of 10 to 40 % in dry summers due to water stress [1]. There are no exact figures on the fraction irrigated potato land in Belgium but estimations indicate that approximately 5 % of the total planted area is irrigated [2]. Due to the high water stress sensitivity potato is one of the crops likely to suffer from global climate change. Objective of this study is to calculate the climate impact on water availability and future irrigation need for Belgian potato production.

## Materials and methods

A soil water balance is used to calculate the climate impact and the future irrigation need of potato. The model is used for irrigation scheduling in yearly approximately 30 Belgian potato fields since 1989. During these years crop parameters, such as transpiration coefficients were calibrated with moisture measurements taken every three weeks during each growing season. This results in a well calibrated soil water balance for Belgian climatological and agronomical conditions (Fig 1).

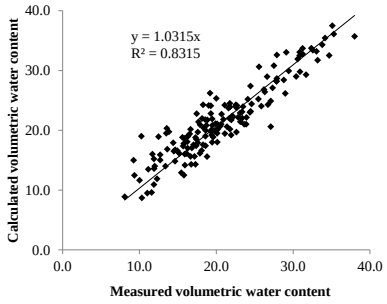


**Fig 1: Correlation between calculated and measured volumetric water content (%) in 2012 over 30 potato fields in Belgium.**

Three climate change scenarios, derived for Belgium [3], were used as input for the simulations: a high scenario (HI), a mean scenario (MI) and a low scenario (LO) (Fig 2a, b). Scenarios for 2066 to 2095 were calculated with the CCI-HYDR [3] perturbation tool based on ETo and rainfall series recorded in Uccle Belgium between 1961 and 1990. Calculations were made for a silt soil and sand soil on which potatoes most frequently are grown in Belgium. A 15 year reference period between 1998 and 2012 was compared to a forecast period between 2073 and 2087. Irrigation need (I) was defined as the water quantity necessary for an optimal production. Yield reduction due to water stress was derived from actual evapotranspiration ($ET_a$) and maximal evapotranspiration ($ET_m$) [4]. The coefficient used to relate production deficit to evapotranspiration deficit was 1.18 as observed in Belgian field trials [1].

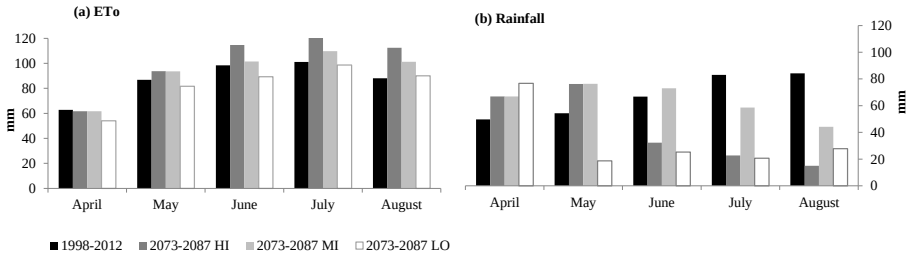


**Fig 2: Current ETo and rainfall compared with the forecasted High (HI), Mean (MI) and Low (LO) climate change scencario derrived from climate series in Uccle (Belgium).**

## Results

In the reference period (1998-2012) average yield reduction due to water stress in non-irrigated potatoes was 21% for sand and 15% for silt soils. In the most extreme HI scenario yield reduction for non-irrigated potatoes increased for the forecast period (2073-2087) to 61% for sand and 51% for silt. In the milder MI scenario yield reduction was 33% for sand and 24% for silt (Fig 3a, b).

Average irrigation need (I) in the reference period (1998-2012) for an optimal production was 121 mm for sand and 80 mm for silt. I in the forecast period (2073-2087) in the HI scenario was 250 mm for sand and 213 mm for silt. In the MI scenario I evolved to 156 mm for sand and 112 mm for silt (Fig 3c, d).

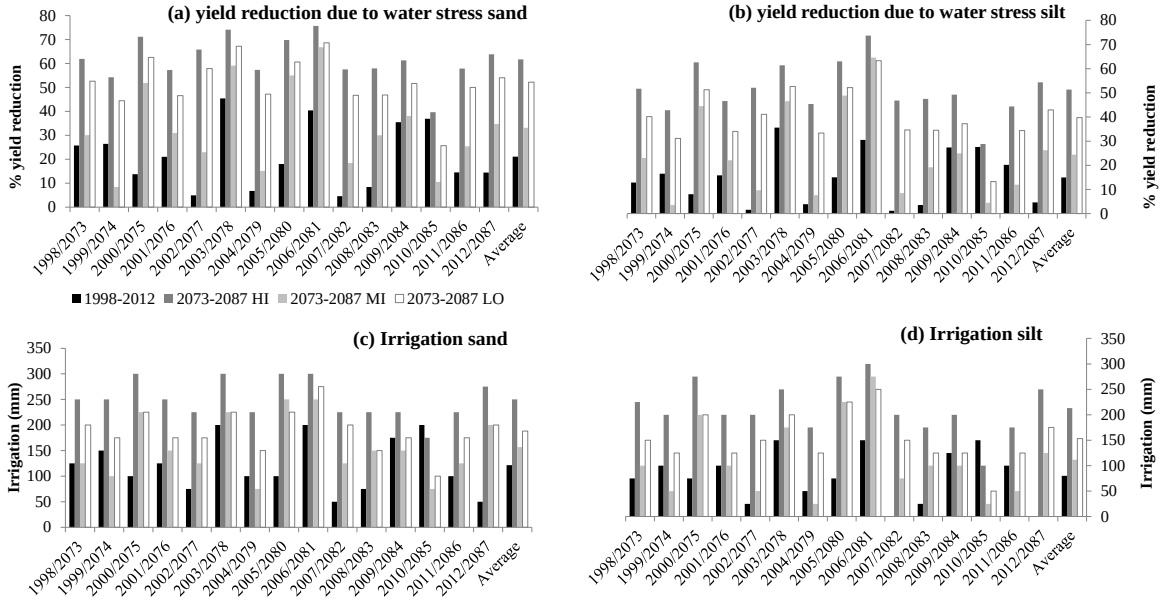


**Fig 3: Yield reduction due to water stress for non-irrigated potato in sand (a), silt (b) and irrigation need for an optimal production (I) in sand (c) and silt (d)**

## Conclusions and perspectives

The dramatic yield reductions in this study are consistent with previous general figures for Belgium [5]. However the calculation neglects beneficial effects on crop yield due to altered $CO_2$ availability for the plant in the atmosphere [6]. Further study with incorporation of the altered $CO_2$ availability is necessary to finalize yield and irrigation need predictions for Belgian potatoes.

## References

[1] Elsen F., Bries J., Vandendriessche H., Geypens M., 1995. Watervoorziening en kunstmatige beregening In: Bries J., Vandendriessche H., Geypens M., 1995 Bemesting en beregening van aardappelen in functie van opbrengst en kwaliteit. 249 p, Brussels, Belgium.

[2] FAO AQUASTAT http://www.fao.org/nr/water/aquastat/main/index.stm.

[3] Ntegeka V., Boukhris O., Willems P., Baguis P., Roulin E., 2008. Climate change impact on hydrological extremes along rivers and urban drainage systems in Belgium. II. Study of rainfall and ETo climate change scenarios. CCI-HYDR project. Report to the Belgian Federal Ministry of Science Policy. Catholic University, Leuven, available at www. kuleuven.be/hydr/cci/reports/CCI-HYDR_II-Climate ChangeScenarios.pdf.

[4] Doorenbos J., Kassam AH., 1986. Yield response to water. FAO Irrigation and drainage paper. FAO, Rome, Italy.

[5] Gobin A., 2010. Modelling climate impacts on crop yields in Belgium. Climate Research 44,55-68.

[6] Vanuytrecht E., Raes D., Willems P., 2011. Considering sink strength to model crop production under elevated atmospheric $CO_2$. Agricultural and Forest Meteorology 151,1753-1762.