

The effect of potato cultivar differences on parameters in WOFOST

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Introduction

WOFOST is a generic crop model which has been applied for many crops including potatoes (de Wit *et al.*, 2018). However, some of the crop parameter sets require revision as they are outdated. For example, for potato the values for important parameters were derived from cultivar Bintje (Wang *et al.*, 2018). Bintje was popular in the 1960s to 1980s but has now largely been replaced by modern cultivars. Therefore, the objectives of this study are to update the model parameters for potato in WOFOST and consider if these differences matter for model calibration using data from new experimental trials. This should provide farmers, industry and researchers with an improved cultivar-specific model results that can be used for estimating yield potentials, impact of water and nitrogen management, and impacts of climate variability and change.

Our focus is on parameters related to photosynthesis and biomass allocation. It is expected that there will be differences between modern cultivars and the current model values, most apparent in biomass allocation, less so for photosynthesis.

Materials and Methods

To explore the effect of different cultivars, irrigation and soil, two experiments were designed in the Netherlands, one on a clayey soil in Lelystad and one on a sandy soil in Vredepeel. Cultivars were selected for their differing lateness. In Lelystad, these were 'Innovator' (lateness: mid-early), 'Fontane' (mid-late) and 'Markies' (late) were used and in Vredepeel 'Premiere' (early), 'Fontane' and 'Festien' (late). Two irrigation and three nitrogen fertilization treatments (Figure 1A) were used to allow for calibration of potential, water-limited and water-and-nutrient limited yield.

Measurements ran from June until final harvest. The dry weight of the stems, leaves and tubers was measured to estimate the fraction of biomass partitioned to stems (FSTB), leaves (FLTb) and tubers (FOTB). Combined with leaf area data the dry weight was used to estimate the Leaf Area Index (LAI) and the specific leaf area as a function of the development stage (SLATB). Chlorophyll and light interception (from June until crop senescence) and photosynthesis (around the time of maximal LAI) were done to allow for calibration of the maximum leaf CO₂ assimilation rate (AMAXTB, EFFTb) and intercepted light (Fint). All measurements were done on all treatment combinations, except for CO₂ assimilation, which was only done on well irrigated well fertilized plots.

Results and discussion

At the time of writing, leaf senescence is still ongoing in some plots (Figure 1B). Therefore, data collection is still ongoing and data analysis has not been completed. So far, there are large differences in aboveground biomass, yield and chlorophyll between the cultivars, between treatments for the same cultivars the differences are smaller. The nitrogen application had a stronger effect than the water treatments, especially on the clayey soils in Lelystad with more abundant rainfall resulting in smaller differences between the irrigation treatments. Differences in AMAXTB between the cultivars were small.

Conclusion

The data analysed so far indicates that AMAXTB does not differ much between cultivars around maximum LAI. Therefore, AMAXTB at this date is of less interest in model calibration than phenology, FSTB and FLTB. Data collected during the season suggests that yield potentials and impact of water and nitrogen management, differ per cultivar, which is relevant when using WOFOST.

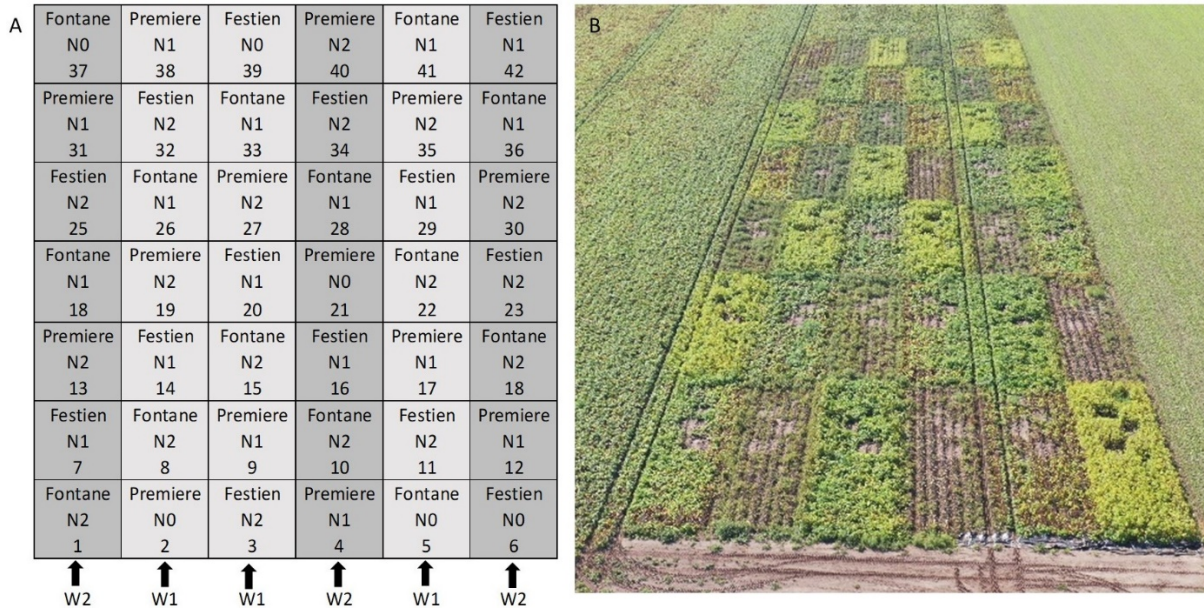


Figure 1: Experimental field in Vredepeel. In A) the plot layout. Cultivar names are written out. W indicates irrigation treatments. W2 was kept at a pF of 2.4 and W1 between 3.2 and 3.4. N indicates fertilisation with N0 being no nitrogen applied, N1 30 percent of advised nitrogen and N2 130 percent of advised nitrogen applied. In B) the field as on the 2nd of September, 2019.

References:

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