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 However, some of the crop parameter sets require revision as they are outdated.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 Bintje was popular in the 1960s to 1980s but has now largely been replaced by modern cultivars.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 CO_2 assimilation rate (AMAXTB, EFFTB) and intercepted light (Fint). All measurements were done on all treatment combinations, except for CO_2 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.

A

Fontane N0 37	Premiere N1 38	Festien N0 39	Premiere N2 40	Fontane N1 41	Festien N1 42
Premiere N1 31	Festien N2 32	Fontane N1 33	Festien N2 34	Premiere N2 35	Fontane N1 36
Festien N2 25	Fontane N1 26	Premiere N2 27	Fontane N1 28	Festien N1 29	Premiere N2 30
Fontane N1 18	Premiere N2 19	Festien N1 20	Premiere N0 21	Fontane N2 22	Festien N2 23
Premiere N2 13	Festien N1 14	Fontane N2 15	Festien N1 16	Premiere N1 17	Fontane N2 18
Festien N1 7	Fontane N2 8	Premiere N1 9	Fontane N2 10	Festien N2 11	Premiere N1 12
Fontane N2 1	Premiere N0 2	Festien N2 3	Premiere N1 4	Fontane N0 5	Festien N0 6
↑ W2	↑ W1	↑ W1	↑ W2	↑ W1	↑ W2

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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