Connecting wireworm-damages in potatoes with meteorological data

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Wireworms are the soil living larvae of click-beetles (Fam. Elateridae). Several species can cause severe yield loss to various crops. Recently, increasing damages have been observed in Europe, which might partly be attributed to climate change.

MELES obtained anonymised potato damage data from the potato packaging company LAPRO ("LANDESPRODUKTEN – HANDELSGESELLSCHAFT M.B.H, Grafendorferstraße 18, A-2000 Stockerau"), covering the period from 2002 - 2019.

In the preceding project COMBIRISK, MELES had developed a first model approach based on the wireworm damage data from 2002 – 2015, for simulating wireworm damage risk in potatoes on basis of air temperature between the calendar days 60 – 84 and the precipitation between the days 1 – 84 (INCA data). Using temperatures and precipitation till end of March allowed the model to forecast the yearly wireworm damage risk before potato planting in April. The model was valid for an important potato production area in north-eastern Lower Austria (region "Weinviertel") and performed quite well for the years 2002 – 2015, with a hit rate of 80 % (= correct classification of yearly wireworm damage risk).

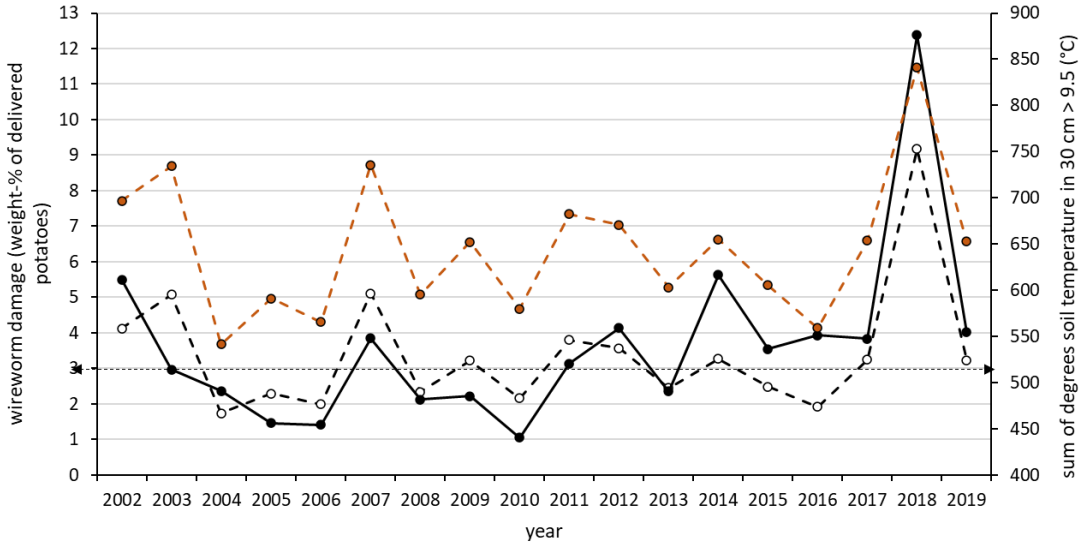
In project AGROFORECAST, MELES validated this model with damage data from the following years 2016 – 2019 and corresponding weather data from the INCA system.

In 2018 the wireworm damages in the region "Weinviertel" reached a very high level that had never been measured before, which is also represented in the LAPRO data. The model "mean.model.1 (COMBIRISK)" contains a positive relationship between temperatures in March and the wireworm damages in the same year. The causality behind this correlation could not yet be clarified. However, as the March temperatures in 2018 were comparatively low, a very low damage risk level for this year was simulated in the validation. Hence, for the sample of the new data from 2016 - 2019, the model showed a weak performance.

In a next step within AGROFORECAST, MELES investigated, if the temperatures during an extended period in spring showed a more reliable relationship to wireworm damages (representative subsample for the years 2016 – 2019). Additionally, the aim was to design an independent variable in correspondence to known facts from wireworm biology, to enhance the interpretability of a resulting model.

For a first model approach ("soiltemp.spring.model.1"), MELES summed up the soil temperatures (30 cm soil depth) between the days 60 – 176 (24th or 25th of June = around the beginning of *A. ustulatus* flight activity) that were higher than the development threshold of *Agriotes ustulatus* (ca. 9.5 °C; Furlan 1998), a dominant wireworm species in the region "Weinviertel". The soil temperatures were calculated from air temperature data with an algorithm designed by J. Eitzinger for the Panel on Animal Health and Welfare (2015). This variable showed a significant positive correlation with the yearly wireworm damages. Based on this relationship a new model approach was developed ("soiltemp.spring.model.1"). Since the soil temperatures between the days 60 and 176 were

comparatively high in 2018 (red dashed line in Figure), the model simulates the excessive damage year 2018 correctly. However, for the years 2014 - 2017 the performance is currently low.



Model approach (**"soiltemp.spring.model.1**"), based on the **soil temperatures in 30 cm** (sum of temperatures > 9.5 °C between the days 60 - 176): **black continuous line, filled circles** = course of the measured mean wireworm damage level per year (weight-% of damaged delivered potatoes, LAPRO company, preliminary – *model calculated with subsample*); **black dashed line, empty circles** = simulated values, the data of the whole period 2002 – 2019 were used for the development of the regression model; **red dashed line with orange filled circles**: course of soil temperature > 9.5 °C in 30 cm soil depth (sum between days 60 – 176) = the independent variable, used in the model.

Till end of the project AGROFORECAST this model approach will be further developed with temperature sums in other or additional periods and additional variables, which is already in progress. The completed damage database (2002 – 2019) together with accompanying weather data from the INCA and ARIS systems, is the basis for further model development and validation. The model performance using downscaled seasonal forecasts from the ZAMG will be tested. The damage forecasts derived from the model will be evaluated and discussed together with stakeholders.