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RISK ASSESSMENT FOR FROST KILLING OF WINTER SUGAR BEET BY MODELING THE BEET CROWN TEMPERATURE

**Modélisation de la température du collet de la betterave afin de déterminer les risques d'un coup de froid mortel sur des betteraves automnales /
Modellierung der Temperatur des Rübenkopfes zur Bestimmung des Risikos letaler Frostschäden an Winterrüben**

ABSTRACT

The cultivation of sugar beet as a winter crop in Central Europe will require tolerance of severe frost. Due to the large variation of survival rates in different environments it is necessary to quantify the risk of frost killing for potential growing regions. The presented approach includes the following steps: (i) Determination of the lethal temperature of sugar beet crown tissue. (ii) Development of a regression model that accurately estimates the temperature of beet crown tissue from readily available weather data. (iii) Assessment of the risk for frost killing in four regions of beet cultivation, representing different climatic conditions in Central Europe.

In field trials at six environments, temperatures (air, soil, crown tissue) were measured during winter and survival rates were determined after winter.

A crown tissue temperature below 6 °C was a reliable indicator for frost killing. The crown temperature was accurately predicted from standard weather data using multiple linear regression models including the parameters 'daily mean air temperature', 'daily mean soil temperature at 5 cm depth' and 'daily snow depth'. By additionally including the 2-fold interactions of regressors and the air and soil temperatures of the previous day into the model, the prediction was further improved.

Risk assessment for frost killing in potential Central European growing areas was based on weather data of the past 20 years. Our approach showed that only at locations with mild winters, such as Cologne, the successful cultivation of winter sugar beet is possible with little risk of frost killing. Growing winter sugar beet at places like Göttingen and Regensburg holds a high risk for frost killing. Finally, our approach needs to be improved with more accurate estimates of crown tissue temperature, and a more precise determination of the lethal temperature of winter beets.
