A Causal Network Approach to Improve Knowledge of Climate Change Impacts on Sweet Potato in Uganda

Hannah R. Young[1,2] | Lindsay C. Todman[3] | Javier A. Miret | Rosalind J. Cornforth[2] | Theodore G. Shepherd[1] | Celia Petty[4] | Donal M. O'Sullivan[3] | Carol Wagstaff[5] | John A. Seaman[4] | Dai Clegg[4] | Miriam Talwisa[6]

1. Introduction

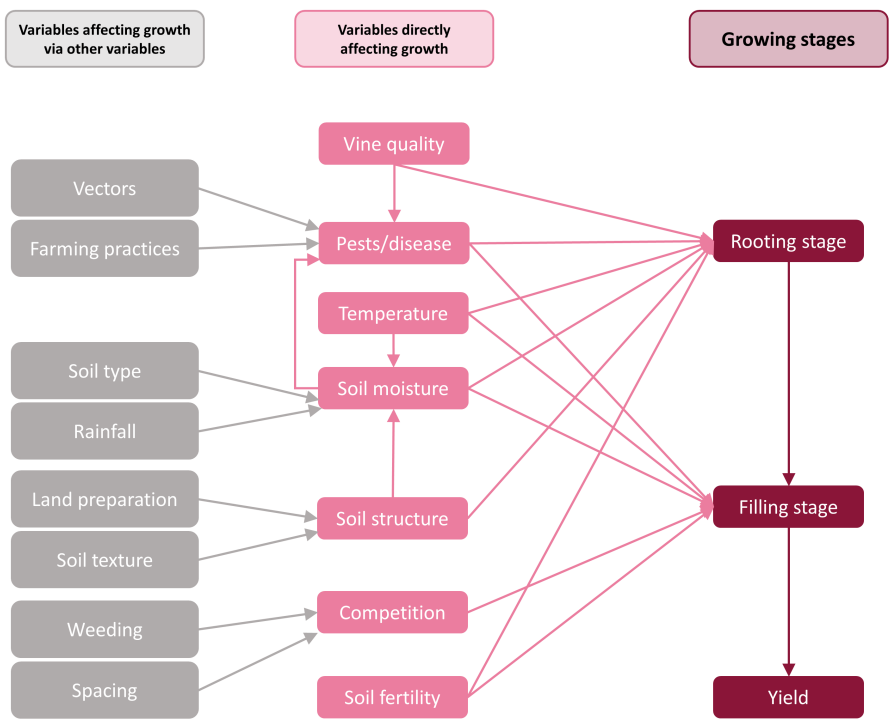
Sweet potato is a mainstay of household food security and a major source of vitamin A across sub-Saharan Africa, and particularly in Uganda. Understanding how climate change is likely to impact on sweet potato would be useful for policymakers in Uganda making decisions to improve food security and increase resilience to climate shocks. However, sweet potato is an under-researched crop and the effects of climate change have not been systematically analysed. Crop-climate models do not include all of the factors affecting sweet potatoes and there are greater model uncertainties than for other major crops. To address these challenges, we are developing a causal inference network for sweet potato in Uganda to characterise the effects of different climate conditions.

2. Methodology

We have developed a causal network structure for sweet potato in Uganda based on interviews with sweet potato experts in Uganda and Kenya (n=6). In each interview, we asked about how to grow the best possible crop and what factors would negatively affect a crop. Based on this conversation, we drew out a network of the different factors affecting sweet potato crops at different growing stages with the interviewee.

The networks from the individual interviews were then combined to produce a network structure characterising the links which multiple interviewees thought were important for sweet potato crops.

3. Network structure



Causal Network Approach

Causal networks represent a set of key variables and how they interact to cause an effect. A network provides a framework to combine information from different sources, including models, observational data, and expert knowledge. A network can then be used to understand the links between the variables and how these interact to influence sweet potato, through analysing the conditional probabilities associated with each variable in the network.

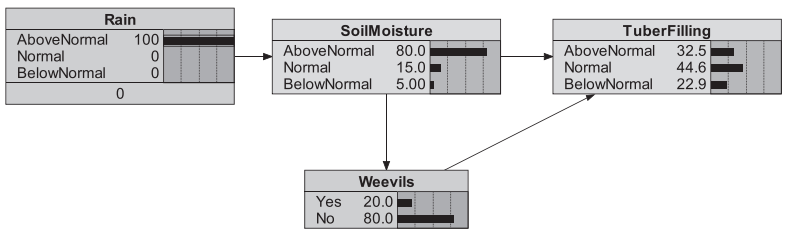
4. Next steps

Working from this network structure, we will quantify the links between the variables by calculating the conditional probabilities associated with each variable. We split each node in the network into categories (e.g. using critical thresholds) and quantify the effect of the different states of parent nodes on the likely state of the child node.

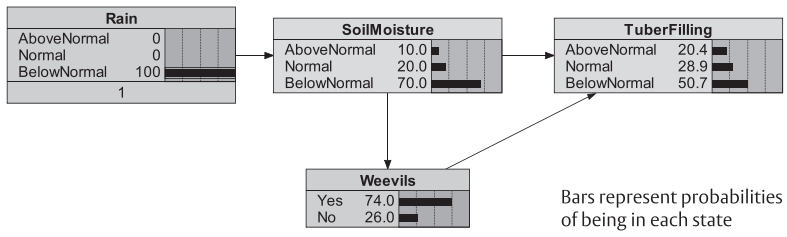
Example conditional probabilities

For a subnetwork, the examples below show how we will use conditional probabilities to quantify the links in the network and predict likely outcomes from known conditions. The numbers shown are for demonstration purposes only.

Effect of above normal rainfall on tuber filling stage



Effect of below normal rainfall on tuber filling stage



Bars represent probabilities of being in each state

To understand how different factors might affect the probability of high or low sweet potato yield we will use:

- Crop modelling using AquaCrop and SPOTCOMS e.g. effects of soil moisture and temperature
- Literature reviews e.g. effects of pests, disease and vine quality

The information from this network will be combined with other datasets including on livelihoods, climate and hydrology within the Integrated Platform for African Policy Makers (IDAPS), which is being developed by the Walker Institute and Evidence for Development. This will enable users to access output visualisations and create their own livelihood-impact scenarios to inform decision-making.

Acknowledgements

This project is funded by the University of Reading through a GCRF Strategic Grant. We thank the interviewees for their time and sharing their knowledge with us.

Contact information

[1]Department of Meteorology, University of Reading
[2]School of Agriculture, Policy and Development, University of Reading
[3]Walker Institute, University of Reading
[4]Evidence for Development
[5]School of Chemistry, Food and Pharmacy, University of Reading
[6]Climate Action Network-Uganda
Email: **hannah.young@reading.ac.uk**