



CEPHaS Project Briefing

No.6 October 2019

RECENT ACTIVITIES IN STATISTICS

The CEPHaS project is a partnership of researchers from Zambia, Zimbabwe, Malawi and the UK addressing how conservation agriculture (CA) practices affect the behaviour of water in soil, crop and groundwater systems. Sound statistical methods, including sampling, experimental design and data analysis are critical to our objectives, and one of the project working groups, WG4, specializes in statistical methods. As well as offering consultancy and training, WG4 is undertaking research on statistical topics.

Design

A design is the set of rules by which treatments are allocated to experimental units such as plots. Efficient design ensures that we can detect effects of interest, without wasting resources.

In the CEPHaS project a new experiment has been designed at the University of Zambia farm in Chongwe district near Lusaka; and the statistical group has helped colleagues to design and analyse data on soil properties from the plots. We have also analysed data from a long-term CA experiment at Chitedze in Malawi, examining treatment effects, and showing what this experiment can teach us about efficient design for experimental work on CA.

Analysis

We use a method called generalized additive modelling to examine differences among treatments in large time series data sets from soil water sensors (Figure 2a). Figure 2b shows the estimated mean drying curves for soil under maize-soybean intercrop (CA) and conventional maize. The shape of the curves does not differ (which we expect, as this was from the first



Figure 1 Drone image of the CA experiment at Chitedze, Malawi.

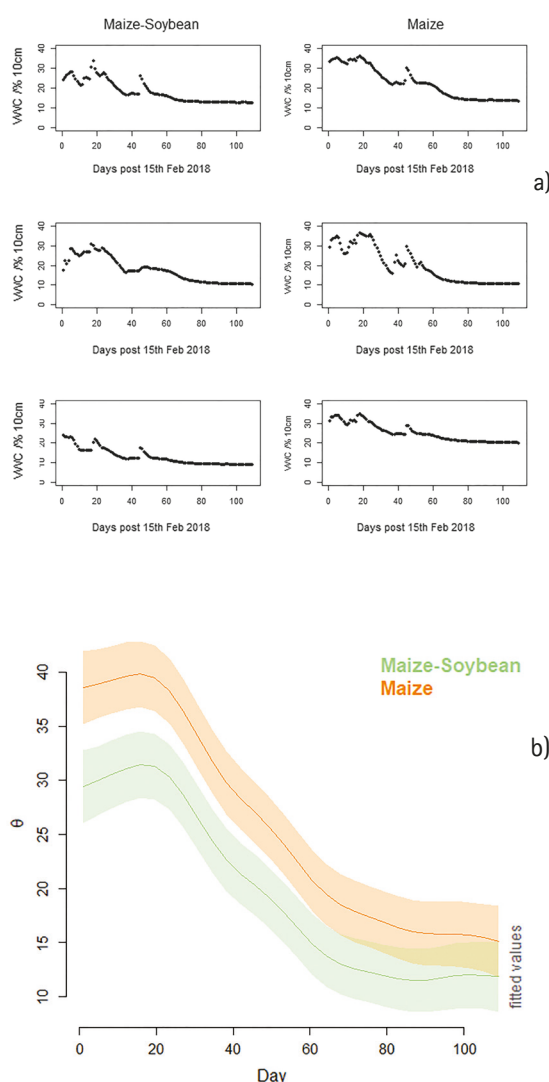


Figure 2 Data (a) on water content in the topsoil of six plots at the UNZA farm and (b) estimated general drying curves for soil under maize or CA maize-soybean intercrop.

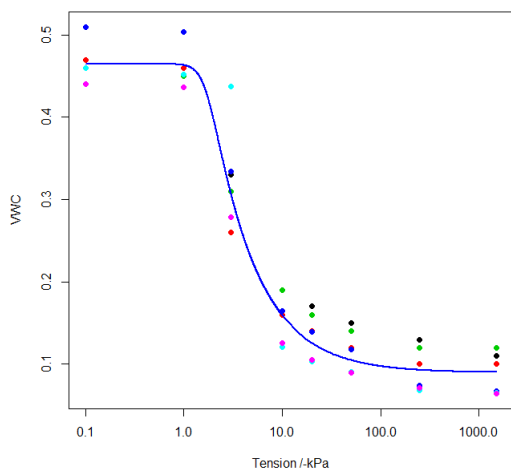


Figure 3 Soil water release curve fitted to a set of observations on the water content of soils at different suctions.

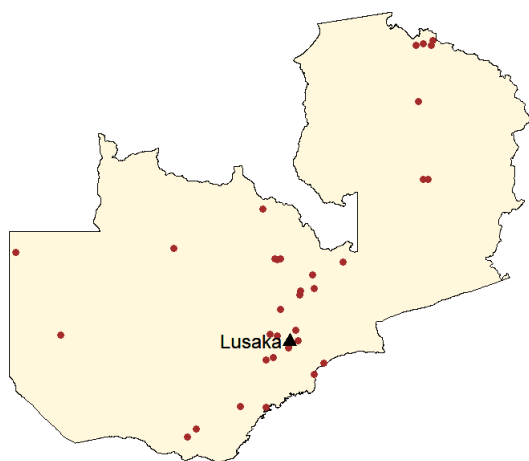


Figure 4 Locations of legacy data on soil physical properties in Zambia.

year of the trial), but overall the soil was drier under the intercrop, perhaps because of additional soil disturbance when the intercrop was established.

Modelling

We are examining how to fit models to data on basic soil physical properties. We are using linear mixed modelling to fit soil water release curves to data which the CEPHaS labs are producing. These curves relate the water content of the soil to the suction applied to it. They are needed for models of water in soils, roots and plants. We have shown that a method called expectation maximization gives more robust mixed model fits than do other approaches which soil scientists have tried.

Prediction

We are working on the development of pedotransfer functions: equations to predict hard-to-measure properties of the soil from those routinely recorded in soil surveys. To do this we are examining legacy data from past surveys and studies. The use of such data requires careful statistical treatment to obtain robust results.

The CEPHaS project statistical group has produced a checklist for the design of experiments which is available from this site <http://nora.nerc.ac.uk/id/eprint/519477>

WHO ARE WE?

We are soil scientists, agronomists, hydrogeologists, geo-physicists, statisticians and agricultural economists from the University of Zimbabwe, the University of Zambia, Lilongwe University of Agriculture and Natural Resources, the University of Nottingham, Rothamsted Research, Liverpool School of Tropical Medicine and the British Geological Survey. We are also joined by Kasisi Agricultural Training Centre as an NGO partner.

Together we constitute a unique multidisciplinary team with a wide range of experience, including in capacity strengthening.

OUR PARTNERS

We are working with the Zambian Agriculture Research Institute (ZARI), the Department for Agricultural Research Services (Malawi), and our commercial partner, Delta-T Devices (UK).



CEPHaS is funded by UK Research and Innovation through its Global Challenges Research Fund programme.

HOW CAN I FIND OUT MORE?

- Contact us at cephas@bgs.ac.uk
- Follow us on twitter @CEPHaS_Soil
- Look out for opportunities to attend project stakeholders workshops
- If you wish to subscribe to this series of project briefings please contact us

