# Spring barley production in the climate change hot spot – Czech Republic as a case study.

**M. Trnka** (1), M. Dubrovský (2), P. Hlavinka (1), D. Semerádová (1), Z. Žalud (1)

(1) Institute for Agrosystems and Bioclimatology, Mendel University of Agriculture and Forestry Brno, Czech Republic, mirek_trnka@yahoo.com

(2) Institute of Atmospheric Physics, Academy of Sciences of the Czech Republic,

Prague, Czech Republic

Central Europe is located between East and South European climate change hot-spots where its impact is thought to become visible sooner or will be more pronounced (or both). Despite the fact that agriculture is by no means a dominant activity in the region it remains an essential part of economy (and landscape) and in many cases it specializes on production of selected crops including spring barley. It is obvious that production stability and quality would be influenced under changed climatic conditions and that these changes will be locally depended. In order to assess trends, magnitude and effect of adaptation strategies we applied crop model CERES-Barley. This model was evaluated using data from 17 experimental sites with 230 experimental years in total. The experimental database was also used to verify whether the model correctly simulates differences in crop growth processes caused by varying farming techniques, climatic and soil conditions. In order to carry out spatial analysis the model was run for all combinations of 125 weather stations using 400 soil pits using special software package: Marwin. The results were then interpolated into a 1x1 km grid matrix using ArcInfo GIS software and only grids covered by arable land were analyzed further.

Estimates of future climatic conditions are based on of A2 and B1 emission scenarios and ECHAM, HadCM and NCAR-PCM global circulation models. The scenario values were used to set up boundary parameters of the future climate over the Czech Republic (including $CO_2$ levels required as an input for the crop model). In the next step synthetic weather series were generated for each of 125 weather stations and centered for time periods centered on years 2025, 2050 and 2100. In order to estimate future yields more realistically both long-term trends in grain production yields (accredited to technological advance) and effects of simple adaptation strategies were taken into account. The latter included optimization of fertilization and sowing dates, changing basic parameters of the cultivar and finally measures to increase soil water accumulation during winter that precede to sowing.

**Results:** We have found that CERES-Barley depicts well interannual variability of Central European spring barley production as e.g. the coefficient of determination between the simulated and experimental grain yields was higher than 0.70 at most sites and systematic bias was acceptable. The “indirect” effect related to changing climatic conditions was found to be mostly negative especially due to higher water deficit during vegetation season. The magnitude of the “direct” effect of increased $CO_2$ on the stressed yields is quite significant but its manifestation remains to be seen in practice (and might be overestimated by the CERES-Barley model). During some seasons (especially for SRES-A2 and ECHAM based outputs) even a strong direct $CO_2$ effect would not outweigh the negative influence of deteriorated climate conditions. Therefore rather high uncertainty about future yields does exist through out regions of Central Europe and this could be said about spring cereals in general. Results also indicate that introduction of few rather simple adaptation measures would in most years (except extremely dry ones) allow maintaining at least the present yield levels on the country level. This would be also helped by sustaining the rate of technological advance that have been taking place over past four decades. Still the model outputs show that some areas will likely suffer from much higher yield variability than nowadays with frequent chance of crop failure whilst others regions (especially those in higher altitudes) will likely benefit through increased temperatures and/or global radiation.

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